Salmonella arizona Infections in Latinos Associated with Rattlesnake Folk Medicine

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Abstract: In 1987 two Los Angeles County (California) hospitals reported four Latino patients with serious *Salmonella arizona* (*Salmonella* subgroup 3) infections who gave a medical history of taking rattlesnake capsules prior to illness. Capsules supplied by the patients or household members grew *Salmonella arizona*. We reviewed surveillance data for this *Salmonella* species and conducted a case-control study to determine the magnitude of this public health problem. Eighteen (82 percent) of the 22 Latino cases in 1986 and 1987 who were questioned reported ingesting snake capsules compared to two (8 percent) of 24 matched Latino controls with non-subgroup 3 salmonellosis or shigellosis (matched pair odds ratio = 18.0, CI = 4.2, 76.3). An average of 18 cases per year of *Salmonella arizona* were reported in the county between 1980 and 1987. In this investigation the majority of *S. arizona* cases reporting snake capsule ingestion had underlying illnesses such as acquired immunodeficiency syndrome (AIDS), diabetes, arthritis, cancer. The capsules were obtained primarily from Tijuana, Mexico and from Los Angeles, California pharmacies in Latino neighborhoods. Despite publicity and attempts to remove the capsules from sale in California, *Salmonella arizona* cases associated with snake-capsule ingestion continue to occur. (*Am J Public Health* 1990; 80:286–289.)

Introduction

In early 1987, two hospitals in Los Angeles County (California) reported four cases of *Salmonella arizona* (*Salmonella* subgroup 3, formerly *Arizona hinshawii*) infection in Latino patients to the Los Angeles County Department of Health Services. All patients gave a history of ingesting rattlesnake capsules prior to the onset of illness; in all four cases, culture of the rattlesnake capsules from the patients' supply or from their household grew *Salmonella arizona* and other enteric bacteria.[1] The patients had underlying chronic medical illnesses including acquired immunodeficiency syndrome (AIDS) and cancer, and the bacteria were isolated from extragastrointestinal sites (blood, pleural fluid, lymph node). We conducted an investigation to define further the epidemiology of rattlesnake-capsule ingestion and *Salmonella arizona* infections in Los Angeles County.

Methods

Surveillance data for *A. hinshawii* and *S. arizona* infections were reviewed for 1980–87. A matched case-control study was performed in late 1987 and early 1988. All Latino cases of *S. arizona* reported to the Los Angeles County Department of Health Services during 1986 and 1987 were eligible. Each case was matched to one or more persons with either *Salmonella typhimurium, Salmonella enteritidis,* or *Shigella*. *Salmonella* controls were chosen from 1986 and 1987 while *Shigella* controls were chosen from 1987. Cases were matched on race and age. Controls were at least 17 years old.

All cases of salmonellosis and shigellosis occurring in Los Angeles County are routinely administered a standard two-page questionnaire covering demographics, clinical information, and potential exposures. These data were supplemented by non-blinded administration of a telephone questionnaire which contained information regarding rattlesnake-pill ingestion, underlying illness, and folk medicine usage. Most interviews were conducted in Spanish by bilingual investigators. Serotype data for all *S. arizona* isolates submitted to the Los Angeles County Public Health laboratories during 1986–87 were reviewed.

Time of exposure was defined as the date to the nearest week, month, and/or year in some cases that the patient reported taking rattlesnake capsules. Since many of the patients were interviewed six months or more after their illness, they often had to estimate these dates. Estimated incubation period was defined as the interval between most recent exposure to rattlesnake pills and date of onset of illness or date of first positive culture, if illness onset date was unclear.

Unless otherwise specified, Mantel-Haenszel matched analysis was used to determine odds ratios and 95 percent confidence intervals (CI).

Results

An average of 18 cases a year of *S. arizona* were reported in Los Angeles County during 1980–87 (Figure 1). The number of cases ranged from nine in 1984 to 33 in 1987. In 1986–87, 45 (85 percent) of 53 such cases were Latino, while 208 (31 percent) of 673 cases with other common *Salmonella* serotypes were Latino (95 percent CI of proportion difference = 0.43, 0.65).

Twenty-two cases were interviewed with the supplemental questionnaire. Not surprisingly, we were able to contact more of the 1987 cases (18 of 29) than 1986 cases (four of 16). The age and geographic distributions of *S. arizona* cases not included were similar to those of interviewed cases. Matched controls included 12 *Salmonella* patients from 1986–87 and 12 *Shigella* patients from 1987. The pool of potential *Salmonella* controls in the proper age range was small. Age matching of cases and controls was ±10 years for 96 percent of the matches; the largest age difference was 14 years.

The median age of cases was 44 years with a range of 16 to 61 years. The male-to-female ratio of interviewed cases was 2.7:1 while that for all Latino *S. arizona* cases was 1.5:1. Cases lived throughout the County but were concentrated in neighborhoods within central Los Angeles. The birthplace or national background of rattlesnake capsule-exposed cases was predominantly Mexico (72 percent).

Eighteen (82 percent) of the 22 cases gave a history of rattlesnake-capsule exposure compared to two (8 percent) of

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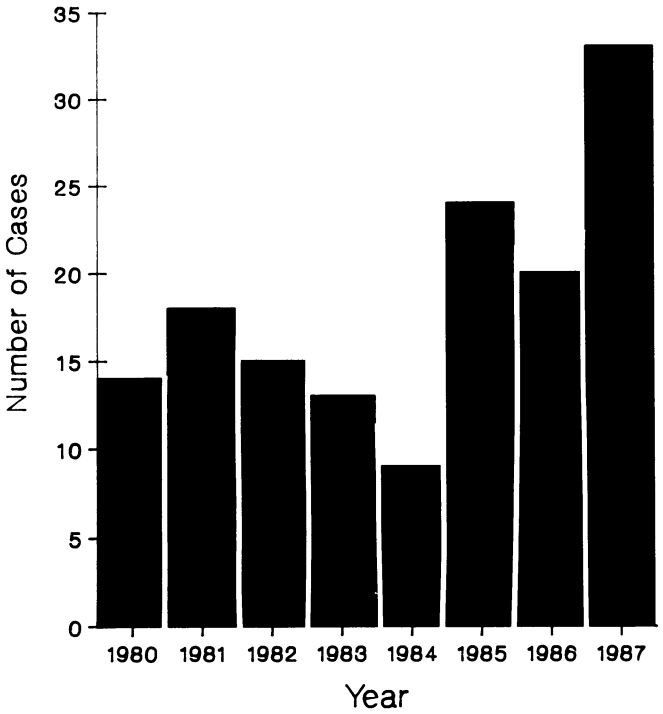

FIGURE 1—Cases of *Salmonella arizona* by Year, Los Angeles County, California 1980–87

24 matched controls (OR = 18.0, CI = 4.2, 76.3). The attributable fraction of *S. arizona* cases due to rattlesnake-capsule exposure in the Latino population is 77 percent.

Ten (56 per cent) of the 18 cases took fewer than 10 capsules over a period of a week or less. Five patients took only two or three pills. One patient ingested capsules daily for four months. The interval between exposure and onset of symptoms or first positive culture ranged from within a week to four years. Eleven (73 percent) of the 15 cases for whom an incubation period could be estimated became ill within three months. Two of the patients with longer estimated incubation periods had perirectal abscesses (Table 1). No correlation was observed between number of pills ingested and incubation period or site of infection.

The reasons patients used rattlesnake capsules included treatments for AIDS, arthritis, blood disorders, cancer, infections, itchy feet, sinus and skin conditions, and diarrhea. The majority of rattlesnake capsules were obtained from Tijuana, Mexico and from Los Angeles, California pharmacies. Patients also reported purchasing rattlesnake capsules in other Mexican border cities, in Central America, from a street vendor, at a local "swap meet" and from a friend. Capsules sold in Los Angeles cost about 20 cents per capsule. Forty-one percent of cases and 54 percent of the controls used other common folk medicines including yerba buena and other herbs and teas.

Feces, blood, and lung or pleural fluid were the most common sites of *S. arizona* isolation (Table 2). All three patients with multiple positive sites of *S. arizona* isolates had AIDS. The antibiogram of one isolate showed sensitivity to ampicillin and all other antibiotics tested.[1]

Fourteen (64 percent) of the 22 cases studied were hospitalized for *S. arizona*-related illness. Two patients had multiple hospitalizations for their infections. One other case was hospitalized for unrelated congestive heart failure. The remaining seven cases were managed as outpatients. The median stay for *S. arizona* cases hospitalized once was 17 days.

Cases with *S. arizona* infection were significantly more likely to have an underlying chronic illness than *Salmonella* controls (OR = 6.7, CI = 1.1, 42.1). The most common chronic conditions among cases included AIDS (five cases), diabetes (four cases), and connective tissue disease (three cases); one case had both diabetes and connective tissue disease, and one case each had heart disease, cancer, and an illness of unknown etiology. Five of six *S. arizona*-infected cases (83 percent) without underlying disease had the bacteria isolated from feces only compared to one of 16 (6 percent) infected chronically ill patients with such an isolation pattern (95 percent CI of proportion difference = 0.33, 1.0). In unmatched analysis, controlling for chronic illness, cases were more likely than *Salmonella* controls to have an extragastrointestinal site of infection (OR = 26.3, CI = 1.4, 500). Three of six *S. arizona* patients without underlying

TABLE 1—Summary of Four Latino *S. arizona* Cases with Estimated Incubation Periods Greater Than Three Months, Los Angeles County, 1986–87

Case No.	Date of Exposure to Rattlesnake Capsules	Date of First Positive Culture	Site of Positive Cultures	Chronic Illness	Comment
7	March 1987	8/13/87	Lung, urine	AIDS	Patient diagnosed with AIDS January 1987. Because the patient had chronic fever, the date of onset with regard to *S. arizona* is unclear.
17	1982	3/26/87	Perirectal Abscess	Adult onset diabetes mellitus and rheumatoid arthritis.	Perirectal abscess first developed in June 1986 and recurred. Patient gave no history of symptoms which could be related to *S. arizona* infection prior to this time.
20	Early 1986	12/12/86	Perirectal Abscess	None	The date of onset is unclear. Patient took rattlesnake capsules for four months.
21	1985	9/8/86	Feces	None	Patient was hospitalized for 12 days during August 1986 for spinal surgery and received prophylactic antibiotics. Patient developed diarrhea during the hospitalization.

TABLE 2—Sites of Positive Cultures for *Salmonella arizona* by Disease Status in 22 Latino Patients, Los Angles County, 1986–87

Site of Isolate	No. Cases (%)			
	Normal Host (n = 6)	AIDS (n = 5)*	Other underlying conditions (n = 11)	Total (n = 22)
Feces	5 (83)	2 (40)	1 (9)	8 (36)
Blood		3 (60)	3 (27)	6 (27)
Lung or pleural fluid		2 (40)	2 (18)	4 (18)
Urine		1 (20)	2 (18)	3 (14)
Perirectal abscess	1 (17)		1 (9)	2 (9)
Wound			2 (18)	2 (9)
Lymph node		1 (20)		1 (5)

*One patient had positive blood and feces cultures, a second patient has positve lymph node, pleural fluid and feces cultures, and a third patient had positive lung and urine cultures.

illness (50 percent) were hospitalized with their infection.

Death occurred in six cases and one control. Three of the *S. arizona*-infected patients who died had AIDS. *S. arizona* infection was not listed as the direct cause of death in any of the cases. However, three patients had positive blood cultures for *S. arizona* within two months of their death and the infection appears to have exacerbated their condition.

Eighteen of 49 (37 percent) *S. arizona* isolates from the Latino cases were either serotype 3a 53:z_4,z_{23},z_{32}:-(n = 9) or 3a 21:z_{29}:-(n = 9) compared to none of 10 isolates serotyped from non-Latino patients in 1986 and 1987 (95 percent CI of proportion difference = 0.18, 0.57, Table 3). Both of these serotypes were cultured directly from rattlesnake capsules as were two other serotypes, 3a 61:1, v:1,5,7 and 3b 50:4:z, which were also isolated from both Latino and non-Latino patients. The 10 isolates of the latter two serotypes were all from feces, whereas 17 (94 percent) of the isolates of the former two serotypes were from extragastrointestinal sites.

Discussion

This investigation of Los Angeles County residents shows that human *S. arizona* cases are relatively common and that over three-fourths of recent *S. arizona* infections in Latinos are linked to rattlesnake capsules. Rattlesnake-capsule ingestion by persons with invasive *S. arizona* infection has been previously documented in case reports.[1–4] All of these cases were Latino patients who resided in the Southwest and had underlying disease.

Capsules cultured from *S. arizona* cases or households have been positive for *S. arizona* and other enteric bacteria.[1,2] The capsules are made of dried ground rattlesnake flesh and are known by several names including polvo de vibora, carne de vibora, or vibora de cascabel. The ingestion of snake preparations is an old popular folk remedy of Mexico and Central America and is used for a variety of medical conditions.[1,5] In this investigation, the majority of patients acquired the capsules from the border city of Tijuana, Mexico and from Los Angeles, California pharmacies or "farmacias" and "boticas" which serve the Latino community.

Reptiles constitute the major reservoir of *S. arizona*.[6–9] Other animal sources from which this bacterial species has been isolated are various fowl and rodents as well as opossums, goats, swine, dogs, and minks.[10,11] Foodborne outbreaks of *S. arizona* gastroenteritis have been reported associated with ice cream, cream pie, eggs, and egg powder.[12,13] Extragastrointestinal disease has been reported in patients with liver abscesses, septic arthritis, brain abscesses, pleural fluid infection, osteomyelitis, and cholecystitis.[12,14–16]

This surveillance study and case reports[1–4] indicate that underlying medical conditions are present in the majority of *S. arizona* cases who ingest rattlesnake capsules. Our findings suggest that *S. arizona* infections are at least as likely as other *Salmonella* serotypes to result in septicemia and focal

TABLE 3—*S. Arizona* Subgroup Serotypes by Ethnicity and Source of Isolation Los Angeles County, California 1986–87

Serotype	Number of Isolates				
	Latino		Non-Latino		
	Extragastrointestinal	Intestinal	Extragastrointestinal	Intestinal	Rattlesnake Capsules
G:z_4,z_{23}:-	1				
18:z_4,z_{23}:-	1				
18:z_4,z_{32}:-	1		1		
21:z_{29}:-	8	1			1
40:z_4,z_{23}:-	3				
40:z_4,z_{24}:-		1			
40:g,z_{51}:			2		
43:z_{24},z_{23}:-		1		2	
48:g,z_{51}:-				1	
48:z_{36}:-					1
48:i:z	2	1			
50:z_4,z_{24}:-	1				
50:k:z:z_{53}				1	
50:r:z		2		2	1
53:z_4,z_{23}:-	1				
53:z_4,z_{23},z_{32}:-	9				1
53:z_{29}:-					1
56:z_4,z_{23}:-	3	1			
60:r:e,n,x,z_{15}		3			
61:1:z		1			
61:1,v:1,5,7		5		1	1
65:(k):z	1				
O rough:z_4,z_{23}:-	2				
O rough:z_4,z_{23},z_{32}:-					1
TOTAL	33	16	3	7	7

infections in patients with significant underlying disease.[17–19] The predisposing disease process alone or in association with treatments such as corticosteroids, chemotherapy, radiotherapy and antibiotics can interfere with host-resistance mechanisms. Edwards, *et al,*[12] have suggested, on the basis of isolation site proportions, that *S. arizona* may be more invasive than other *Salmonella* species. Our analysis using *Salmonella* controls and controlling for chronic disease is consistent with this possibility as is the 50 percent hospitalization rate in cases without underlying illness. Further, our data on *S. arizona* serotype distribution by isolation site and that of Weiss, *et al,*[20] suggest that invasiveness may be serotype-specific. In both studies, serotype 61:1,v:1,5,7 stands out as relatively noninvasive.

Most of the patients in this study ingested fewer than 10 rattlesnake capsules. Riley, *et al,*[1] found 10^5 *S. arizona* organisms per gram in one sample. Capsules weigh an average of 700 mg and, thus, the infectious dose of *S. arizona* may be as low as 10^5 or 10^6 organisms. For the many patients with reduced resistance who take rattlesnake capsules, the infectious dose may be even lower.

Although the incubation period for *Salmonella* gastroenteritis is usually 24–36 hours, four study persons apparently were indolently infected for months to years before developing signs of illness or before positive cultures were obtained. Prolonged intestinal carriage of *Salmonella* bacteria is a well recognized phenomenon; chronic illness or other factors such as surgery or disruption of intestinal flora due to antibiotics may have triggered active infection in these patients.[21] Two persons, one with underlying illness and one a normal host, had perirectal abscesses which could have been present for some time but were undetected. While recall and interviewer bias is possible, we believe the histories of rattlesnake capsule ingestion are accurate because interviewers described or denied such exposure without hesitation.

Five cases who were exposed to rattlesnake capsules had an underlying condition of AIDS. Investigators at Los Angeles County/University of Southern California Medical Center have recently reported on four of these patients.[1] Human immunodeficiency virus (HIV) infection has been shown to predispose patients to serious *Salmonella* infections.[22,23] Salmonellosis in persons with AIDS is characterized by widespread infection, bacteremia, and relapse even with standard antibiotic therapy. Through September 1988, over 900 cases of AIDS in Latinos have been reported in Los Angeles County, and the proportion of Latino AIDS cases has increased 133 percent from 9 percent to 19 percent between 1982 and 1988.* Thus, the dangers of rattlesnake-capsule exposure should be emphasized to Latinos due to their increasing pool of AIDS victims and the propensity of some to use folk remedies.

Physicians and health care workers should be aware of the potential for *S. arizona* infection from ingesting rattlesnake capsules and the prevalence of this practice. The State of California Department of Health Services Food and Drug Branch has taken action to prevent further distribution of the products and to remove the capsules from pharmacies and markets known to distribute them. Distributors were also requested to recall the products. Perhaps because of these actions and publicity in both Spanish and English, only 12 *S. arizona* cases linked to rattlesnake capsule ingestion were reported in Los Angeles County in 1988. Continued occurrence of cases is not surprising given the availability of rattlesnake pills in local Latino neighborhoods and along the US-Mexico border. Health agencies and community groups should pursue education of the Latino population about the risks and absence of medical benefit from rattlesnake capsules.

*Lieb L: AIDS Epidemiology Program, Los Angeles County Department of Health Services, personal communication, 1988.

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