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A Series of *Salmonella* Food Poisoning Outbreaks Occurred at one International-Class Hotel in Taichung City, Taiwan

Abstract

On 2-4 February 1999, the Yulong Motor Company in Sanyi, the Tunghai University's Office of Academic Affairs, and the Department of Psychiatry of the Changhua Christian Hospital had their year-end feast separately at one international class hotel in Taichung City. Many had developed food poisoning-like symptoms such as nausea, vomiting, abdominal pain, diarrhea, fever and chilliness after the dinner. This investigation applied the case-control method to study the staff and their dependents of the Department of Psychiatry, of the Changhua Christian Hospital, and invited guests. The purpose was to investigate the causes of this series of food poisoning outbreaks and to identify the responsible food items and pathogenic agents.

Ages of the 112 (47 males and 65 females) persons interviewed ranged from 1 to 67 years, with a median of 29 years. Ninety-four of them complained having symptoms such as diarrhea (84.0%), abdominal pain (74.5%), chilliness (72.3%), fever of 38℃ and above (68.1%), headache/dizziness (68.1%), weakness (45.7%), nausea (37.2%), and vomiting (26.6%). Of them, 77 met the criteria of a case. Incubation periods ranged from 4 to 37 hours, with a median of 19 hours.

Statistical analysis showed that the wined chicken was associated with the outbreak. The odds ratio of those who had this dish was 3.83 times (95% confidence limit of 1.44-19.16) higher than that of those who did not. Common food items consumed by the staffs of the Yulong Motor Company, the Tunghai University, and the Changhua Christian Hospital were fried celery with jellyfish, lamb in jelly, and wined chicken. The wined chicken was the likely cause.

Furthermore, *Salmonella bareilly* was isolated in 80.0% (12/15), 76.9% (10/13) and 78.6% (11/14) of the rectal swabs collected respectively from staffs of the Yulong

Motor Company, the Tunghai University, and the Changhua Christian Hospital. The laboratory of the Changhua Christian Hospital also isolated *Salmonella* serotype O7 in 68.8% of their Psychiatry Department staff. Epidemiological information collected through questionnaire interview of the victims showed that their distribution of symptoms and incubation periods corresponded to the characteristics of Salmonella infection. They all indicated that *Salmonella bareilly* was the pathogenic agent of the serial food poisoning outbreaks.

Introduction

On the evening of February 2, 1999, 41 key staff of the Yulong Motor Company and their Japanese consultants had dinner at one international-class hotel restaurant in Taichung City. Around 10 o'clock of that evening, 35 of them began to develop symptoms such as vomiting, diarrhea, abdominal pain, and fever. They were sent to clinics in the Sanyi area and the Taichung Veterans General Hospital for care. At noon of the next day, 33 employees of the Office of Academic Affairs of the Tunghai University had lunch at the same hotel restaurant. Around 5 pm of the same day, 22 of them began to show symptoms such as nausea, vomiting, abdominal pain, diarrhea, fever, and were taken to hospitals. On the evening of February 4, 127 staff members of the Department of Psychiatry of the Changhua Christian Hospital, their dependents and invited guests had buffet dinner at the same hotel restaurant. On the early morning of February 5, 80 of them started to show symptoms such as nausea, vomiting, abdominal pain, fever, chilliness, and were taken to the Changhua Christian Hospital for care. Many cases were so serious to be admitted for in-patient care.

Rectal swabs were immediately collected from cases for laboratory testing by the Central Branch Laboratory of the National Institute of Preventive Medicine, Department of Health. The Field Epidemiology Training Program (FETP) also sent a team for epidemiological investigation. The purpose was to investigate the causes of the outbreaks, and to identify the responsible food items and pathogenic agents.

Materials and Methods

The FETP team, in collaboration with the local health bureaus, conducted a semi-structured questionnaire interview at the Yulong Motor Company in Sanyi, the Tunghai University, and the Changhua Christian Hospital. The questionnaire contained questions on the background information of the case, symptoms, date and time of onset, medical care, and food items consumed. Thirty-one persons interviewed at the Yulong Motor Company showed a return rate of 75.6% (31/41) as 10 key staff and Japanese consultants went abroad on business. At the Tunghai University, 32 persons were interviewed with a return rate of 97.0% (32/33). The size of the samples (31 and 32) was not large enough to identify the food items likely responsible for the outbreak. One hundred and twelve staff members, their dependents, and invited guests of the Changhua Christian Hospital were interviewed at a return rate of 88.2% (112/127). This sample size was large enough for meaningful study. Therefore, the present investigation used the information collected from the

Changhua Christian Hospital for statistical analysis.

The Miaoli County Health Bureau collected 15 rectal swabs of the key staff members and Japanese consultants at the Yulong Motor Company. The Taichung City Health Bureau also collected 13 rectal swabs from the employees of the office of Academic Affairs of the Tunghai University. The Changhua County Health Bureau collected 14 rectal swabs from the staff members, their dependents, and invited guests at the Changhua Christian Hospital. They were all sent to the Central Branch Laboratory of the National Institute of Preventive Medicine for testing *Staphylococcus aureus* and enterotoxins, *Bacillus cereus*, *Salmonella*, pathogenic *Escherichia coli*, and *Vibrio parahaemolyticus*. The laboratory of the Changhua Christian Hospital also conducted testing of the rectal swabs of its employees.

The Taichung City Health Bureau also collected 21 specimens of food materials such as finless eel, jellyfish, cuttle fish, wined chicken, lamb in jelly, shrimp, crab ovary, shark's fin, lotus leaf, shellfish, grouper, mushrooms, rice, chicken legs, crab meat, chicken meat, and dessert. They also collected seven environmental specimens such as ice cubes from the kitchen, water from the grouper tank, kitchen water, drinking water, soup bowls, knives and spoons. They were sent to the Central Branch Laboratory of the National Laboratories of Foods and Drugs for testing for *Staphylococcus aureus* and enterotoxins, *Bacillus cereus*, *Salmonella*, pathogenic *E. coli*, and *Vibrio parahaemolyticus*.

Information collected through questionnaire interview was keyed into computers with Epi-Info software and verified item by item. The background of those interviewed was presented. The distribution of symptoms and the odds ratio of each food item and the 95% confidence limit(CL) were calculated. SAS® software was then used to conduct multiple logistic regression analysis[2] to identify the likely responsible food item.

Findings of laboratory testing of human specimens were used to confirm the pathogenic agents and to define cases by the distribution of symptoms and incubation periods. A confirmed case was defined as one who had the buffet dinner on the evening of February 4, 1999 at the hotel in Taichung City, later developed diarrhea (more than twice a day) and at least two of the following symptoms, abdominal pain, nausea, vomiting, fever, chilliness, weakness, and *Salmonella Bareilly* was isolated from his/her rectal swab. When no *Salmonella Bareilly* was isolated, the case was then defined as a suspected case. Others were not counted as either a comfirmed case or suspected case.

Results

A total of 112 staff members, dependents, and invited guests of the Changhua Christian Hospital were interviewed. Of them, 47 (42.0%) were males and 65 (58.0%) females. Their ages ranged from 1 to 67 years, with a median of 29 years. Ninety-four (83.9%) of them had developed symptoms and 73 (77.7%) were cared medically. Their symptoms included diarrhea (84.0%, 79/94), abdominal pain (74.5%, 70/94), chilliness (72.3%, 68/94), fever of 38 ℃ and above (61.8%, 64/94),

headache/dizziness (68.1%, 64/94), nausea (37.2%, 35/94), vomiting (26.6%, 25/94), and weakness (45.7%, 43/94). Of the 94, 77 met the criteria of a case; 44 were confirmed cases and 33 suspected cases. Incubation periods collected from the 74 cases who remembered the date and time of onset were shown in Figure 1. The incubation periods ranged from four to 37 hours, with a median of 19 hours.

The results of food item analysis (Table 1) showed the odds ratios and their 95% confidence limits for smoked flounder, Sesame broiled eel, wined chicken, broiled shellfish, and coffee were 3.46 (1.29-9.52), 2.91 (1.16-7.40), 5.11 (2.00-13.29), 3.12 (1.26-7.78), and 0.32 (0.13-0.82) respectively. Since the 95% confidence limit of above food items did not contain 1.00, they were all statistically significant. The odds ratios of smoked flounder, sesame broiled eel, wined chicken and broiled shellfish were all larger than 1.00, they were considered risk factors related to the food poisoning outbreaks. The odds ratio of coffee was smaller than 1.00, it was thought as a protective factor. The 95% confidence limits of all other food items covered 1.00, they were not statistically significant, and less likely to be associated with the food poisoning outbreaks.

As ages of the participants of the dinners could have some impact on the manifestation of symptoms, age was treated as a confounding factor in the analysis of multiple food items. Its results were shown in Table 2. When age was adjusted, wined chicken (odds ratio of 3.83, 95% confidence limit of 1.44-10.16) and coffee (odds ratio of 0.28, 95% confidence limit of 0.10-0.75) were still statistically significant. The former was the risks factor and the latter was the protective factor of the food poisoning outbreak.

Laboratory testing by the Central Branch Laboratory of the National Institute of Preventive Medicine isolated *Salmonella bareilly* in 12 of the 15 rectal swabs collected from the Yulong Motor Company; in 10 of the 13 rectal swabs collected from the Tunghai University; and in 11 of the 14 rectal swabs collected from the Changhua Christian Hospital. The laboratory of the Changhua Christian Hospital further isolated Salmonella serotype O7 in 44 of the 64 infected employees. However, no *Salmonella* was isolated from the rectal swabs of the 15 cooks and staff of the hotel restaurant. No *Salmonella* was isolated from the 21 food and 7 environmental specimens, either.

Conclusion and Discussion

There are three types of *Salmonella, Salmonella typhi/Salmonella paratyphi, Salmonella choleraesuis,* and *Salmonella enteritidis.* They can be further classified into various serotypes by O and H antigens. *Salmonella typhi* and *Salmonella choleraesuis* each has only one serotype. *Salmonella paratyphi* has three serotypes; whereas *Salmonella enteritidis* has more than 1,500 serotypes[3,4]. The isolation rates of *Salmonella bareilly* at the Yulong Motor Company, the Tunghai University, and the Changhua Christian Hospital were relative high at 80.0% (12/15), 76.9% (10/13), and 78.6% (11/14) respectively. The isolation rate of Salmonella serotype O7 by the laboratory of the Changhua Christian Hospital was also as high as 68.8% (44/64).

Epidemiological information collected through questionnaire interview also showed that the symptoms and incubation periods matched with the characteristics of *Salmonella* infection[5]. These findings indicated that the *Salmonella bareilly* is likely the pathogenic agent.

Common food items consumed by the three institutions were fried celery with jellyfish, lamb in jelly, and wined chicken. Fried celery with jellyfish was prepared before each meal taking relatively little time to prepare, its chance being the food responsible for the serial food poisoning outbreaks was low. Lamb in jelly was prepared by freezing sliced lamb in jelly beforehand. It was served at the time of the dinner. Wined chicken was prepared by soaking chicken legs in wine and herb for at least two days. Both the lamb in jelly and the wined chicken had to be prepared in advance, each preparation served for two to three days. Both lamb in jelly and wined chicken were kept in freezer. If they were contaminated by *Salmonella Bareilly* in the course of processing, preparing or storing, food poisoning could occur. The results of statistical analysis showed that wined chicken was associated with the food poisoning. The odds ratio of food poisoning for those who had eaten the wined chicken was 3.83 times higher (Table 2) than that of those who had not. Wined chicken was, therefore, considered the food item responsible for the food poisoning outbreaks.

Several studies[6-9] have proved that *Salmonella enteritidis* can be isolated from raw chicken meat, and other poultry such as ducks and turkeys[10,11]. Inadequate processing of *Salmonella enteritidis* contaminated poultry could result in food poisoning[10,11]. The present outbreaks were some unfortunate incidents. For the prevention of *Salmonella* food poisoning, kitchen staff of hotel restaurants should be given regular and adequate training in food sanitation, storage and processing of food materials. Hotel restaurants should make it a policy to purchase only CAS certified food materials. CAS is a guarantee of food quality. Sweden, soon after the large-scale *Salmonella enteritidis* food poisoning outbreak of 1963, took immediate action to sample-test chickens on farms[12]. Chickens isolated with *Salmonella enteritidis* were destroyed. Since 1994, the testing has become a routine requirement before the slaughtering of chickens. Ever since, no *Salmonella enteritidis* has been found on chickens and eggs.

Lifestyles in Taiwan have made significant changes. In Europe and the United States, incidents of *Salmonella enteritidis* induced food poisoning are on the rise[13,14]. In Taiwan, many such cases have also been reported[15,16]. Local health authorities should be more alert to this problem and take all necessary precautions to prevent its occurrence.

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Table 1. The Results of Statistical Analysis of Single Food Item in *Salmonella Bareilly* Indncing Food poisoning Outbreak, Taichung, 1999.

Food item	Cases			Non-cases			Odds ratio
	eaten	no eaten	exposure odd	eaten	not eaten	exposure odd	(95% CL)
	(1)	(2)	(3)=(1)/(2)	(4)	(5)	(6)=(4)/(5)	(3)/(6)
Smoked flounder	39	38	1.03	8	27	0.29	3.46(1.29-9.52)*
Sashimi mixture	30	47	0.64	11	24	0.46	1.39(0.55-3.55)
Sesame broiled eel	44	33	1.33	11	24	0.46	2.91(1.16-7.40)*
Spaghetti salad mixture	19	58	0.33	5	30	0.17	1.97(0.62-7.37)
Assorted shushi	42	35	1.20	14	21	0.67	1.80(0.74-4.39)
Chenkjang spicy pork	20	57	0.35	6	29	0.21	1.70(0.57-5.71)
Spiced smoked fish	23	54	0.43	6	29	0.21	2.06(0.70-6.85)
Wined chicken	56	21	2.67	12	23	0.52	5.11(2.11-13.29)*
Fried celery with jellyfish	29	48	0.60	7	28	0.25	2.42(0.86-6.99)
Lamb in jelly	29	48	0.60	7	28	0.25	2.47(0.86-6.99)
Cashew nut	24	53	0.45	9	26	0.35	1.31(0.49-3.55)
Fried mushroom	41	36	1.14	17	18	0.94	1.21(0.50-2.90)
French fry	23	54	0.43	13	22	0.59	0.72(0.29-1.82)
Shrimp ball	51	26	1.96	21	14	1.50	1.31(0.53-3.23)
Crab	27	50	0.54	12	23	0.52	1.04(0.41-2.61)
Broiled beef rib with green onion	29	48	0.60	12	23	0.52	1.16(0.46-2.91)
Broiled shellfish	52	25	2.08	14	21	0.67	3.12(1.26-7.78)*
Steamed sole fish	31	46	0.67	16	19	0.84	0.80(0.33-1.94)
Lamb rib with orange flavor	44	33	1.33	13	22	0.59	2.26(0.92-5.58)
Braised bamboo shoots with mushrooms	17	60	0.28	9	26	0.35	0.82(0.29-2.30)
Stewed mixed vegetable	13	64	0.20	7	28	0.25	0.82(0.26-2.55)
Fried rice	37	40	0.93	18	17	1.06	0.87(0.36-2.09)

Table 1. The Results of Statistical Analysis of Single Food Item in *Salmonella Bareilly* Indncing Food poisoning Outbreak, Taichung, 1999. (continued)

Food item	Cases			Non-cases			Odds ratio
	eaten	no eaten	exposure odd	eaten	not eaten	exposure odd	(95% CL)
	(1)	(2)	(3)=(1)/(2)	(4)	(5)	(6)=(4)/(5)	(3)/(6)
Fried noodle	35	42	0.83	14	21	0.67	1.25(0.52-3.05)
Foo Yung seafood soup	26	51	0.51	10	25	0.40	1.27(0.49-3.35)
Beef sinew borsch	23	54	0.43	8	27	0.29	1.44(0.52-4.04)
Tomato	15	62	0.24	10	25	0.40	0.60(0.22-1.68)
Celery	10	67	0.15	6	29	0.21	0.72(0.21-2.66)
Cucumber	7	70	0.10	6	29	0.21	0.48(0.13-1.92)
Carrot	4	74	0.05	4	31	0.13	0.42(0.07-2.42)
Lettuce	12	65	0.18	6	29	0.21	0.89(0.28-3.20)
Corn	8	69	0.12	7	28	0.25	0.46(0.14-1.59)
Bean sprout	6	71	0.08	6	29	0.21	0.41(0.10-1.68)
Thousand island dressing	14	63	0.22	5	30	0.17	1.33(0.40-5.16)
sweet vinegar dressing	1	76	0.01	1	34	0.03	0.45(0.01-36.14)
Five-flavor dressing	2	75	0.03	2	33	0.06	0.44(0.03-6.36)
Peanut jam vinegar	2	75	0.03	2	33	0.06	0.44(0.03-6.36)
Bacon	2	75	0.03	1	34	0.03	0.91(0.05-55.04)
Crouton	1	76	0.01	3	32	0.09	0.14(0.00-1.86)
Sour bean	1	76	0.01	1	34	0.03	0.45(0.01-36.14)
Olive	1	76	0.01	1	34	0.03	0.45(0.01-36.14)
Sliced onion	1	76	0.01	1	34	0.03	0.45(0.01-36.14)
Rye bread	6	71	0.08	4	31	0.13	0.65(0.14-3.40)
Butter bread	9	68	0.13	5	30	0.17	0.79(0.22-3.29)
Crab ovary	7	70	0.10	8	27	0.30	0.34(0.10-1.15)
Lotus seed paste with yolk	7	70	0.10	7	28	0.25	0.40(0.11-1.42)
Sponge cake of jujube paste	11	66	0.17	5	30	0.17	1.00(0.29-4.00)
French dessert	43	34	1.26	16	19	0.84	1.51(0.62-3.62)
Fruit mixture jelly	18	59	0.31	12	23	0.52	0.58(0.22-1.53)
Assorted fruited	47	30	1.57	16	19	0.84	1.86(0.77-4.52)
Coffee	18	59	0.31	17	18	0.94	0.32(0.13-0.82)*
Red tea	15	62	0.24	4	31	0.13	1.88(0.53-8.38)
Cocktail	53	24	2.21	28	7	4.00	0.55(0.19-1.57)

*statistically significant, $p<0.01$

Table 2. The Results of Multiple Food Items Analysis in *Salmonella Bareilly* Inducing Food Poisoning Outbreak, Taichung, 1999.

Food item	Odds Ratio (95% CL)
Age	0.99(0.96-1.02)
Smoked flounder	1.73(0.60-4.99)
Sesame broiled eel	2.07(0.77-5.58)
Wined chicken	3.83(1.44-10.16)*
Shellfish	2.56(0.98-6.66)
Coffee	0.28(0.10-0.75)**

*p<0.01; **p<0.05; all statistically significant

Figure 1. Distribution of Incubation Periods in *Salmonella Bareilly* Induced Food Poisoning Outbreak, Taichung, 1999.