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Foodborne Botulism in Taiwan, January - May 2010

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Abstract

Clostridium botulinum is an anaerobic, spore-forming bacillus. Neurotoxin produced by *C. botulinum* is the most potent neurotoxins known. Botulism is an important reportable disease because of its risk of death if not treated adequately, the possibility of foodborne outbreaks and can be used for bioterrorism. Both the number of reported and confirmed cases increased in Taiwan this year. Here, we summarize the clinical presentation, diagnosis, management and investigation of these cases.

During January 1 to May 31, 2010, there were 13 suspected botulism cases reported. Nine cases met both the clinical and laboratory criteria and were confirmed as foodborne botulism, including two outbreaks and four sporadic cases. Their mean age is 42 years. Four are male. Most common clinical symptoms include dysphagia, tongue weakness, ptosis and muscle weakness. Half of the patients had gastrointestinal symptoms including diarrhea, abdominal pain, nausea and vomiting. Mouse inoculation test showed that seven was positive for toxin A, one positive for toxin B and one was negative. Antitoxin was administered to eight cases. Eight cases were intubated with ventilator support. In addition, one person died.

Foodborne botulism is a public health emergency. High awareness of clinicians, good cooperation between disease-control and food safety officials are crucial for timely diagnosis and treatment, which can help find the contamination source and prevent future cases.

Key words: *Clostridium botulinum*, botulism, food intoxication

Introduction

In April 2010, an outbreak of suspected botulism cases was reported in northern Taiwan; three cases were confirmed

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by the laboratory. This old, rare, yet severe disease grabbed the attention of the public after a press release was published by the Taiwan Centers for Disease Control. By the end of May 2010, an additional 10 cases were reported; six were confirmed. The numbers reported and confirmed in the same period were the highest for many years. This article summarizes the clinical and epidemiological findings of the confirmed cases.

Methods

1.Case definition: a case was illness in a person meeting the clinical and laboratory criteria for foodborne botulism during January 1 to May 31, 2010.
   (1) Clinical criteria: patient had central nervous system symptoms including visual impairment (blurred vision or diplopia), dysphagia, facial nerve palsy and dry mouth with or without muscle weakness, respiratory failure, gastrointestinal symptoms; and physicians cannot exclude botulism as a diagnosis.
   (2)Laboratory criteria: *Clostridium botulinum* was isolated from a clinical specimen (stool or vomitus) or botulinum toxin was detected in serum.
2.Information source: hospital medical records, Taiwan Notifiable Disease Reporting system, in person interview of cases or family members.
3.Laboratory diagnosis:
   (1) Serum: patient serum was used for mouse inoculation test. Inoculated mice were observed for signs and symptoms of botulism, including respiratory distress, muscle weakness, abdominal respiration, respiratory arrest or failure, or death. Botulinum toxin type was determined by neutralizing the biological activity of toxic samples injected into mice with type A, B, E and F -specific botulism antitoxin.
   (2) Other specimens: specimen was incubated under anaerobic condition for three days. The supernatant was used for the mouse inoculation test as above. Sediment was used for bacteria culture, isolation and identification. Mouse inoculation test was repeated using isolated bacteria.
4.Case investigation and outbreak control: after receiving reports of suspected cases, Taiwan Centers for Disease Control immediately delivered botulinum antitoxin to hospitals where patients were hospitalized, and initiated case investigation to determine if outbreaks exist, and to identify possible sources of toxin. In addition to the symptoms and treatment information provided in the medical records, an accurate onset time was determined

through interviewing the case or family. Detailed food history of the patient three days prior to symptom onset was obtained through the interview, because the incubation period of botulism is usually 12-36 hours. Details included food types, process, storage, quantity taken, and other people who might have shared the same meal. If more than one person shared a meal, the foods taken during that meal was cross checked by interviewing the others, to obtain a complete food history.

Results

1. Demographics of cases

During January 1 to May 31, 2010, there were 13 suspected botulism cases reported. Of these, nine were confirmed and the other four were excluded because they did not meet the clinical criteria and all diagnostic tests for botulism were negative.

All nine confirmed cases were reported in April and May. There were two outbreaks, reported on April 2 and 15, with three and two cases, respectively. The others were sporadic cases. Cases clustered in northern and central Taiwan, including Taipei County (1), Taoyuan County (4), Miaoli County (4), and Taichung County (2). The three cases in Taoyuan belonged to the same outbreak; and the two cases in Miaoli belonged to the same outbreak. The male to female ratio was 4:5. The average age was 42.2 years (standard deviation, 18.6 years; range 15-71 years).

2. Clinical presentations (Table)

The most common clinical presentation was dysphagia (9/9), followed by tongue weakness (4/4), ptosis (8/9), dysarthria (8/9), and muscle weakness (8/9). Other neurological symptoms including facial palsy, respiratory distress, diplopia, and ophthalmoplegia were present in 40-70% of the patients. Approximately half of the patients had gastrointestinal symptoms including diarrhea, abdominal pain, nausea and vomiting. The most common autonomic nerve dysfunction was urinary retention and ileus. None of the cases had conscious disturbance.

In addition, eight patients had dizziness, four had fever (>37.8℃) on admission (two with fever >39°C), four had sore throat or throat tightness, and two had cough. Other symptoms included difficulty opening the mouth, numbness of the fingers and toes, and drooling. None of the patients had wounds at symptom onset. Initial symptoms included dizziness (3), gastrointestinal symptoms including nausea or vomiting, and abdominal pain (2), and cranial nerve palsies including dysphagia, dysarthria, and visual impairment (3); finally, one person had dizziness and dysarthria simultaneously.

3. Laboratory tests and diagnosis (Table)

All cases had serum sample taken before antitoxin administration for laboratory testing. Seven was positive for toxin A, one for toxin B and one was negative for botulinum toxin. Four cases had stool sample before antitoxin administration. Two were positive for *C. botulinum*. Three cases had rectal swabs and one was tested positive. Four had gastric juice sample and all tested negative. For cases had serum samples taken after antitoxin administration, two were negative for botulinum toxin, one was positive for toxin A and the other positive for toxin B. Autopsy was performed on the case who died two days

Table. Clinical presentation and laboratory test results of confirmed botulism cases, Taiwan, January to May 2010

Case number [1]	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**Percentage**[3]
Age(years)	41	61	47	71	44	15	19	53	29	
Gender	F	F	M	F	F	M	M	F	M	
Onset to reporting (days)	3	3	2	3	4	3	6	3	1	
Symptoms										
Cranial nerve										
Dysphagia	O	O	O	O	O	O	O	O	O	100%
Tongue weakness	O	—	—	—	O	O	O	—	—	100%
Ptosis	O	O	O	O	X	O	O	O	O	89%
Dysarthria	O	O	X	O	O	O	O	O	O	89%
Diplopia/ blurred vision	O	O	O	O	O	X	O	X	O	78%
Facial palsy	O	X	X	O	X	O	O	O	O	67%
Respiratory distres	X	X	X	O	X	O	O	O	O	56%
Ophthalmoplegia	X	X	X	O	X	X	O	O	O	44%
Autonomic neve										
Urinary retention/ catheterization	O	O	X	O	X	O	X	O	O	67%
Ileus	O	O	X	O	X	O	X	O	O	67%
Mydriasis	O	O	X	X	X	O	O	O	X	56%
Dry mouth	O	O	X	X	X	X	X	—	—	29%
Peripheral nerve										
Muscle weakness[2]	O (3)	O (4)	O (4)	O (2)	X	O (3)	O (3)	O (2)	O(2)	89%
Gastrointestinal tract										
Nausea/vomiting	O	O	O	O	O	X	X	O	X	67%
Abdominal pain	O	O	X	O	O	X	X	X	X	44%
Diarrhea	O	O	X	O	O	X	X	X	X	44%
Other symptoms										
Dizziness	O	O	O	O	O	X	O	O	O	89%
Fever	X	X	X	X	O	O	O	O	X	44%
Sore throat/tightness	X	X	X	O	O	X	X	O	O	44%
Laboratory results										
Serology	Toxin A	Toxin A	Negative	Toxin A	Toxin A	Toxin A	Toxin A	Toxin B	Toxin A	
Bacterial isolation										
Results	Positive	Negative	Positive	Negative	Positive	Negative	Negative	Negative	Pending	
Specimens	Stool, rectal swab		Stool		Autopsy [4]					

1. Cases 1-3 and cases 4-5 belonged to two separate outbreaks.
2. Number in parethesis reprsents the worst muscle power during the disease course. Full muscle power is rated five.
3. O: with symptom, X: no symptom, —：not recorded in the chart or not available, such cases will not be include for percentage analysis
4. Blood, gastric tissue, colon tissue and ileal stool sample obtained from autopsy were positive for *C. botulinum* on isolation. Mouse inoculation test further confirmed production of toxin A.

after her death. *C. botulinum* was isolated from blood, gastric tissue, colon tissue and ileal stool sample. Mouse inoculation test confirmed the toxin type (toxin A). Molecular study is ongoing to compare the isolated *C. botulinum* strains from different patients.

Among other clinical tests, three had lumbar puncture and the results of cerebrospinal fluid (CSF) tests were normal. Seven had imaging studies because of dysphagia or suspected stroke, including brain computed tomography (CT) in 5, brain magnetic resonance imaging (MRI) in 2 and neck CT in 1 (one patient had both brain CT and MRI performed). Results were all negative. Nerve conduction velocity (NCV) test was performed in six. Four were normal. One had decreased compound action potential and decreased conduction velocity on bilateral facial nerve. The other had incidental findings not associated with botulism (bilateral carpel tunnel syndrome and lumbar disc herniation).

Repetitive nerve stimulation test (RNST) was performed in six. One showed decremented response with low frequency (3 Hz) repetitive stimulation and incremented response with high frequency (20-50 Hz). One had decremented response with both high and low frequency repetitive stimulation. Three had no response to either stimulation, and one had incremented response with only high frequency stimulation.

4. Treatment and case management (Table)

All the cases, except for case 3 in the first cluster, sought medical help on the day of symptom onset or the day after. Botulism was suspected 1 to 6 days after symptom onset and was reported. Except for the case that died, antitoxin was administered to all cases. Three cases had an additional bottle of antitoxin used beyond the standard two-bottle regimen because of clinical symptoms. Case 3 had skin rash after receiving antitoxin. No adverse effect was reported in any other cases. Eight were intubated with ventilator support and all were admitted to intensive care units. Plasmapheresis was performed on case 7 and 8.

By the end of May, all cases survived except for case 5, who died three days after symptom onset.

5. Epidemiological investigation

The nine cases composed of two outbreaks (5 cases) and 4 sporadic cases. In the two outbreaks, food history was more clearly identified and could be cross checked with other people who shared the meal. Ready-to-eat, vacuum-packed soy products were consumed by cases in both outbreaks. Food specimens from the homes of cases were tested by the Taiwan Food and Drug Administration. Because no leftover food was available for testing in most cases, there was no evidence directly linking suspected foods with botulism [1]. Investigation revealed that among the four sporadic cases, two had also consumed vacuum- packed foods during the incubation period. The suspected food had been sampled and laboratory testing is ongoing. For manufacturers of the possibly contaminated food, local health authorities have taken actions to prevent further events from happening.

Discussion

Botulism is ubiquitous in the environment. It produces one of the most potent toxins in nature. Toxins may be categorized into seven types (types A-G).

Most human intoxications are caused by types A, B, and E. Because botulism causes death without prompt treatment, may occur in outbreaks through contaminated food, and be used as a bioterrorism weapon, botulism is an important disease for public health professionals [2]. In Taiwan, botulism has been a reportable disease since 1990. On October 15, 2007, it became a Category IV notifiable disease. During 1991-2006, approximately 3 cases were reported each year. In 2007, 2008, and 209, there were 13, 18, and 4 cases reported, and 8, 11, and 1 case confirmed, respectively. In the first five months of 2010, there has been 13 cases reported, and nine has been confirmed. This is the highest in many years.

After the first outbreak occurred in April this year, Taiwan Centers for Disease Control gave a press release immediately and the event grabbed the public's attention [3]. In addition to being publicized on all major newspapers, the event was reported repeatedly on electronic media. When investigating the following cases, many of the cases' family members and clinicians said that they were informed of botulism by media reports. These reports heightened physician awareness of the disease. Further study is needed to delineate if there are other factors causing the increase in case number.

Botulism can be caused by different type of toxins via different routes, but the clinical manifestations are similar. A typical case has clear consciousness, symmetrical cranial nerve palsies (facial nerve palsy, dysphagia, dysarthria) and descending paralysis. Gastrointestinal symptoms (abdominal pain, diarrhea, nausea/vomiting) and autonomic nerve symptoms (dry mouth, mydriasis) are also common. All nine cases reported here have typical symptoms of different severity. It is noteworthy that four of the nine cases had sore throat or throat tightness. It has been reported that dry mouth can produce pronounced mucosal erythema and pain, which can be mistaken for pharyngitis at disease onset [4]. Furthermore, it has been emphasized that fever is absent in a typical case of botulism unless a complicating infection occurs [5]. Four of the nine cases reported here had fever up to 39°C early in the disease course with no evidence suggestive of other complications. Therefore, we recommend that botulism should not be excluded in patients with fever. Careful evaluation of neurological symptoms and food history is crucial. Any suspected case of botulism should be reported and treated immediately.

Mouse inoculation study is the gold standard for diagnosing botulism. For suspected cases, at least 10 ml of serum must be obtained before antitoxin is administered to complete the diagnosis process, including toxin subtyping. For cases meeting clinical criteria, 33-44% can be confirmed by serological tests [6, 7]. Test sensitivity varies inversely with the time elapsed from symptom onset to sample collection. Generally speaking, botulinum toxin can only be detected in less than 20% of the serum samples obtained more than 6 days after intoxication [6]. On the other hand, some showed that samples obtained 2-3 weeks after ingestion of contaminated food were still tested positive for botulinum toxin [8]. In our case series, two cases were tested more than one week after disease onset and

after administration of antitoxin. Semi-quantitative test result showed that the toxin amount has decreased but was still present. This finding can be attributable either to ingestion of high quantity of toxin or to persistent toxin production by *C. botulinum* in the gastrointestinal tract. *C. botulinum* isolation from stool specimens can also be used to confirm the diagnosis. Using stool specimen for bacteria isolation increases the sensitivity of laboratory testing to 67-73% [7]. Clinically, many of botulism cases suffer from ileus and can not defecate normally. If enema is performed on these patients to obtain stool specimen, the sample is usually diluted and the sensitivity will be decreased. In these cases, we suggest that rectal swab specimens can also be used to increase diagnostic sensitivity. Furthermore, bacteria isolated from stool, gastric juice or other specimens can be used for further molecular studies, which can help in linking different cases [9].

Neuroimaging and electro-physiological studies can be used to exclude other diagnoses, or as ancillary testing to diagnose botulism. A normal brain CT or MRI excludes the diagnosis of stroke. Normal CSF protein level helps differentiate between botulism and Guillain–Barré syndrome. RNST can also be used to help in diagnosing botulism. Classical findings in botulism cases include decremented response to repetitive nerve stimulation at a low stimulation frequency (3Hz) and incremented response at high stimulation frequency (20-50 Hz) [2]. Sensitivity of RNST is technician-dependent, and patients may have different incremented or decremented responses in different stages of the illness. Therefore, it is only recommended as an ancillary test for diagnosis and for follow up [2, 7], rather than as the only diagnostic tool. After initial examinations to exclude other possible diagnosis, all suspected botulism cases should be reported immediately and to be treated as soon as possible.

Administration of antitoxin and provision of respiratory care are cornerstones of botulism treatment. Because botulinum toxin binds irreversibly to the presynaptic neuron, antitoxin can only neutralize toxin that are yet unbound to neuromuscular junction, and prevent the progression of neurological deficits. Return of normal neuromuscular function requires sprouting of a new presynaptic terminal, which takes weeks to months [10]. During the early 20th century, the mortality rate among patients with botulism was 60-70% [11]. After the mid-20th century, the mortality rate decreased to 3-5% because of advances in intensive care medicine, especially mechanically ventilation [2, 4].

Most antitoxins in the market are equine products containing antibodies to toxin types A, B and E. Doctors should monitor for allergic reactions or serum sickness following antitoxin administration. Decades before, when patients were treated with higher doses of antitoxin, approximately 9% had hypersensitivity reactions [6]. In Taiwan, botulism antitoxin is procured and provided by Taiwan Centers for Disease Control. It is also an equine product, and contains 250 ml per bottle with 187,500 IU of type A, 125,000 IU of type B, and 12,500 IU of type E antitoxin. According to the instruction, the recommended standard treatment dose is 2

bottles (500 ml) intravenously. A third bottle may be advisable 4-6 hours later depending on clinical conditions. Patient should be carefully monitored for any immediate severe anaphylactic reaction when infusion begins, and managed promptly for any adverse reactions.

Principles for treating botulism are as follows: 1. administer botulinum antitoxin as soon as possible to prevent progression of neurologic symptoms and shorten the duration of respiratory failure; 2. careful monitoring of respiratory function, and give aggressive respiratory support for those with ventilatory insufficiency as early as possible; 3. give supportive and intensive medical care to avoid further complications, particularly for those with limbs or respiratory paralysis. Because of the rapid onset of respiratory arrest and skeletal muscle paralysis, patients with botulism may not have classical signs of respiratory distress (e.g., accessory muscle use). For persons suspected of having botulism, the vital capacity should be monitored and checked meticulously in an attempt to diagnose respiratory failure early and provide respiratory care. According to literature reports, it takes 26-58 days for patients who need mechanical ventilation to be weaned from ventilator. Studies reveal that early administration of antitoxin is associated with lowered mortality rate, shorter hospital stay and ventilator dependence [2, 7].

Antibiotics are ineffective in the treatment of foodborne botulism. However, when antibiotics are needed for the management of botulism complications, aminoglycosides and clindamycin should be avoided. These antibiotics have been found to exacerbate neuromuscular blockade in both animal studies and few case reports in humans [13]. Plasmapheresis is not a standard treatment of botulism, but it has been performed as an adjuvant therapy in severe botulism in a case report [14].

Obtaining food history is important for differential diagnosis and epidemiological investigation. Detailed information should be collected as possible, before patients are intubated. Once intubated, unless they are sedated, patients may continue to communicate by writing or body movements because of preserved intellectual function. Persons with exposure to the same foods should be queried for any suspected symptoms, to detect potential outbreaks. This was how Case 3 in the Taoyuan County outbreak was detected and diagnosed. If persons who consumed the same food have similar neurologic symptoms, botulism must be considered, reported, and considered for antitoxin treatment [4].

Conclusion

Foodborne botulism is a public health emergency. Collaboration between clinicians, disease-control and food safety officials are crucial for rapid response, timely diagnosis and treatment, which can help in finding the contamination source and prevent future cases.

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Norovirus Outbreak in Residents of a Congregate Institution —Yilan County, 2008

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Abstract

Norovirus infection is one of the most common causes of diarrhea outbreaks. A diarrhea outbreak occurred in a congregate institution in Yilan County in 2008. Officers of first Branch and professionals of the field epidemiology training program of Taiwan CDC in conjunction with officials from the Disease Control Division of Yilan County Public Health Bureau proceeded to the location on October 3, to conduct epidemiological investigations. Objectives of the investigation are to estimate the scale of this diarrhea outbreak, to determine mode of transmission and possible pathogens, and to evaluate the effectiveness of control measures.

During September 29 to October 7, a total of 53 residents at the institution started to show symptoms of diarrhea, vomiting, and other symptoms. Attack rate for males was 2.0%, females 7.1%. Eighty-nine human fecal specimens (including kitchen workers) and six environmental samples were collected and tested with enzyme-linked immunosorbent assay. Of which four resident's fecal specimens and an environmental sample (toilet) contained norovirus. Accordingly, this case has been judged as a norovirus outbreak. Due to the fact that the outbreak was reported quickly and the Yilan County Public Health Bureau intervened in time, arranging isolation and treatment for patients, environmental disinfection, implementation of gastrointestinal tract infection control measures and intensive disease surveillance, this cluster incident was prevented from expansion. The institution implemented comprehensive infection control measures and surveillance for diarrhea symptoms until October 17 and no new cases of diarrhea were detected.

Keywords: norovirus, diarrhea, vomiting, outbreak

Introduction

Norovirus is one of the common pathogens that cause diarrhea. According to NoV capsid gene sequences, it can be divided into GI (genogroup-I), GII (genogroup-II), GIII (genogroup-III), GIV (genogroup-IV), and GV (genogroup-V) [1]. GI, II, IV can infect humans; GIII and GV infect cows and rats. The outbreaks that occur in congregate or health care settings are commonly caused by GII [2]. In Taiwan, the major genogroup causing acute gastroenteritis is GII [3]. Diseases caused by norovirus can occur in any month of the year, but most they mainly occur in winter [4]. Comparing to other gastrointestinal viruses or bacteria, Norovirus

is highly infectious. It takes only 10-100 viruses to cause an infection. It can exist stably in the environment, and can resist general disinfectants [5]. Norovirus can cause infection through the patient's feces or vomit, contaminated food or drink, contacts with patients,or the their caregiver, or through contaminated items [6]. For 348 outbreaks of NLV (Norwalk-Like Viruses) gastroenteritis reported to U.S. CDC during 1996 to 2000, food was implicated in 39%, person-to-person contact in 12%, and water in 3%. A total of 39% occurred in restaurants; 29% occurred in nursing homes and hospitals; 12% in schools; and 10% in vacation settings [7]. Taiwan Epidemiology Bulletin, published by Taiwan CDC, show that the incidents of norovirus outbreaks in recent years are all in congregate settings , such as schools and nursing homes [8-9]. In this case, where a suspected diarrhea outbreak broke out in a congregate institution in Yilan County, officers of first branch of CDC in conjunction with professional of field epidemiology training program and Yilan County Public Health Bureau officers went to the scene to conduct an epidemiological investigation on October 3, 2008. Objectives of the investigation were to estimate the scale of this diarrhea outbreak, to determine mode of transmission, possible pathogens, and evaluate the effectiveness of control measures.

In the past, testing for norovirus had been difficult. Studies of Patel et. al. have indicated that among the majority of gastroenteritis outbreaks in the world, norovirus serves as an important pathogen [10]. Norovirus can attack persons of all ages and induce gastrointestinal symptoms, but adults mostly experience mild symptoms. How norovirus interacts with the human body's immune mechanism is currently unknown. Because there are many different virus strains, it is difficult to establish a life-long immune response for our immune system. After infection, the infected person has only a few months of immunity against the same strain of virus, and thus may be repeatedly infected [7, 11]. Over the past 10 years, the main methods of testing for the norovirus are the Enzyme-Linked ImmunoSorbent Assay (ELISA) and reverse transcriptase polymerase chain reaction (RT-PCR). Feces, vomit, and related environmental samples are used for testing [12]. Kaplan standards may also be used to determine whether the acute gastroenteritis outbreak is caused by norovirus, such as vomiting symptoms appear in more than half of cases, the average incubation period of 24-48 hours, average duration of symptoms of 12-60 hours, and stool cultures are not tested positive of bacterial pathogens. The sensitivity of Kaplan standard is 68%, with specificity of 99%. Turcios et. al. uses Kaplan criteria to determine the 4,050 food poisoning cases during the period of 1998-2000, of which 28% of the pathogens can be attributed to norovirus [13].

Institutional context

The congregate institution is located in the suburb of Yilan County, which accommodates approximately 2,228 inhabitants (female 183, male 2,045) and 270 staff members. The institution is made up of two-story buildings. The main building is box-formation with dorms situated horizontally called Chung, Hsiao, Ren, Ai, Hsin, Yi, Hu, Ping dorms and working plants

vertically situated (1-11 rooms). Each dorm consists of 10 large rooms which can accommodate 12-14 people and 15 small rooms which can accommodate 6-8 people. Each room has an independent and simple sanitary facility. The plant is located on both sides of the various dorms, which can accommodate 100-120 people at the same time for work. Residents work, bathe, and take meals in the factory from Mondays to Fridays and stay in their rooms on Saturdays and Sundays. Residents' drinking water comes from tap water and brought in with buckets from the outside. For washing and flushing, they use underground water. The institution has good water supply equipment with adequate water supply and no water tower installed. Meals are all supplied by the kitchen consisting of 39 residents who are responsible for cooking and food safety was managed separately by other residents groups. For management of food safety for all residents, food for the 39 who are responsible for cooking was prepared separately to prevent large scale of gastro-intestinal outbreak.

This institution is equipped with a sanitation division, which regularly schedules physician for consultation services. All the cases were quarantined for observation in the health section next to the sanitation division. Diarrhea outbreaks were preceded by 2 days of typhoon (September 27, 28) when the residents conducted their daily activities (eating, washing, toileting) within their rooms.

Case definition

Residents of the institution or staff members who presented any one of the following: symptoms of diarrhea twice (including) or more times, abdominal pain, vomiting, fever over 38 ℃ during the time period between September 29, 2008 and October 7, 2008 were classified as cases of this diarrhea outbreak.

Specimen collection and laboratory test results

Yilan County Public Health Bureau collected fecal specimens from 11 persons who were still suffering from diarrhea and sent the samples to Research and Diagnostic Center of CDC. Bacteriological tests included bacillary dysentery and amoebic dysentery; viral test for norovirus. Another 39 stool specimens from the kitchen workers were collected and tested for norovirus; 6 environmental samples from the kitchen and the toilets in the room of cases in the Hsin 2 dorm were also tested for norovirus .In addition, the Public Health Bureau found out that the institution had guest meetings on September 25, so 20 environmental samples from phones were also collected.

Stool specimens from 11 patients were tested with enzyme-linked immunosorbent assay (ELISA) and the results show that 4 were tested positive for norovirus. The fecal specimen test results of 39 kitchen workers were negative for norovirus. Among the 6 environmental samples, one (Hsin 2 dorm toilet) disclosed positive for norovirus. The norovirus detected belonged to GII. None of the 20 samples collected from the phones were tested positive for norovirus.

Description of the outbreak

A total of 53 met the case definition, with 40 males (75.5%) and 13 females (24.5%) and

a total attack rate of 2.4% (53 / 2,218). Attack rate for males was 2.0% (40 / 2,035), females 7.1% (13/183). According to the age data of 42 patients provided by the institution, the age distribution is as following: 20-30 years old 23.8%, 31-40 years old 54.8%, 41-50 years old 11.9%, 51-60 years old 9.5%, with 31-40 year-olds exceeding half of the total. Cases showed symptoms (in order) of diarrhea 92.2%, vomiting 37.5%, and nausea 20.0%. Based on the epidemic curve drawn of the 53 cases (Figure 1), we can see that the index case appeared in Hsiao 1 dorm on September 29, followed by 29 cases on September 30, and then eight on October 1, eight on October 2, three on October 3, two on October 5, and the last two cases on Oct 7. Cases are mainly distributed in the Hsiao 1 dorm (13 persons), followed by Hu 2 dorm (10 persons), Yi 2 dorm (8 persons) and Hsin 2 dorm (7 persons) (Figure 2).

Control and preventive measures

After the outbreak, the Yilan County Public Health Bureau carried out prompt control measures. They recommended the institution to require all those persons showing symptoms to be isolated and to wear face masks in order to reduce the chances of contacts with other residents. Isolated cases were allowed to return to their dormitories 2-3 days after symptoms have been relieved. In addition, disinfection for item that residents have easy access to, such as door handles, bed bars, toilet flushing handles, was conducted. Strengthened monitoring of hand-washing before meals and after using toilets and gastrointestinal tract infections control measures were administered. The health station director also went to the institution to conduct health education advocacy, and closely monitored the number of new cases after the isolation of cases and the prognosis of each case. After the implementation of these control measures, no large-scale human to human infection occurred in the institution. As of October 17, no new cases occurred, showing that the epidemic had been controlled.

Discussion

According to the symptoms of cases and laboratory results, we can determine that the outbreak of diarrhea in this institution was

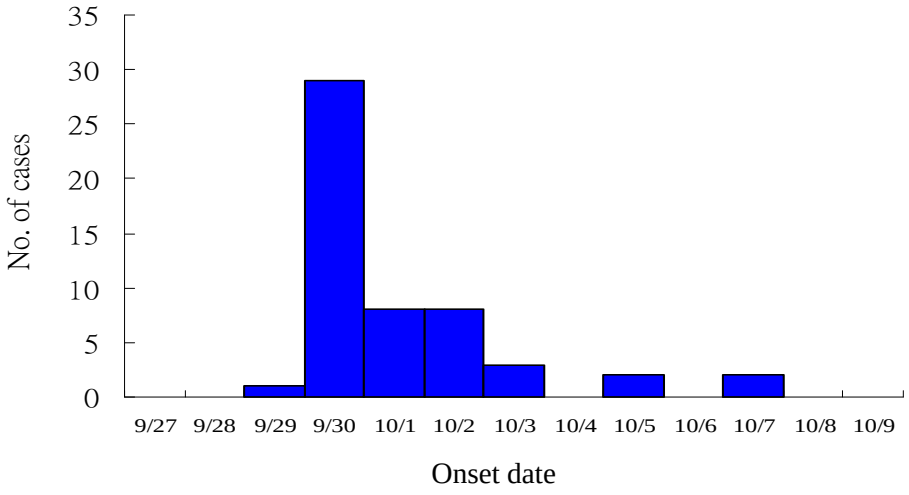

Figure 1. Number of norovirus cases in residents of a congregate institution, by onset date －Yilan County, 2008

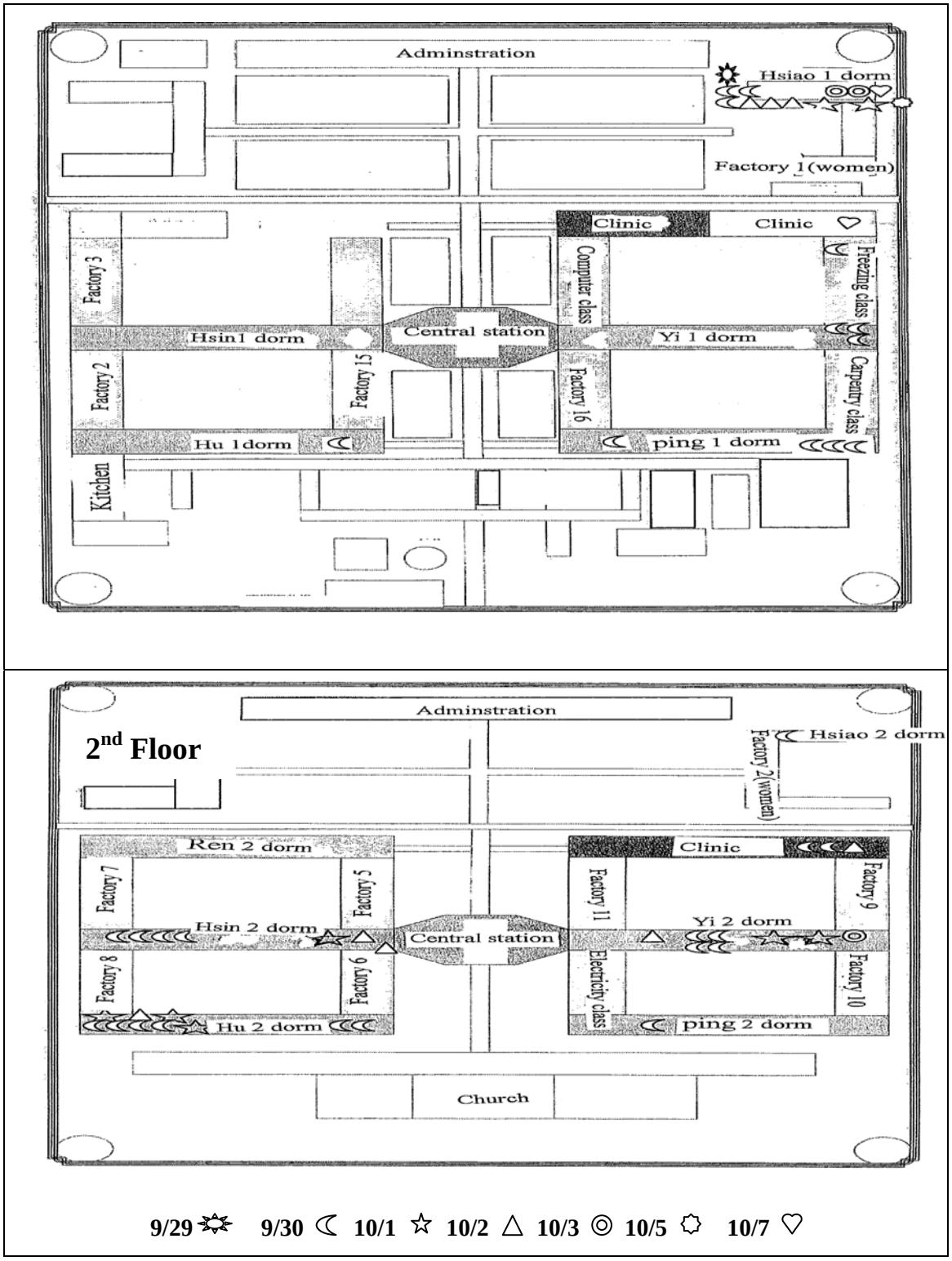

Figure 2. Norovirus case locations in residents of a congregate institution－Yilan County, 2008

caused by norovirus infection. The outbreak increased up to 29 cases on September 30, after the index case appeared on the 29th. After the sharp drop of occurrence after October 1, there were still cases occurred; thus, we inferred that the single-peak pattern points to common exposure infection. Symptomatic residents were living in different premises, and they normally had no joint activities which open opportunities for contact. In addition, the members of the staff of the institution were asymptomatic, and all had fixed premises and plants to be in charge of. The outbreak also coincided with Jangmi typhoon, when all the residents were confined to their own quarters during the 27th, 28th, and 29th of September. All meals and drinking water were brought in from the outside; thus we suspect that the outbreak was caused by common exposure to contaminated food or water. However, it is difficult to detect the norovirus in food and drinking water; therefore it is not verified by further sampling.

A norovirus outbreak had occurred in 2007 in this institution. The recurrence of norovirus outbreak in 2008 showed that the institution still has risk for norovirus outbreaks. Although in this investigation, we could not identify the source of infection. Since the norovirus is usually transmitted through the fecal-mouth route, we suggested that the institution should enhance the planning and implementation of the relevant prevention and control measures of gastrointestinal diseases. Comparing to the outbreak in 2007, which lasted 17 days, with up to 199 cases involved, the scale of this outbreak had showed that the effectiveness of control measures have improved. Risk factors for outbreaks in congregate settings include large number of residents, limited space, without proper implementation of quarantine resulting in the spread of the disease [14]. So it is suggested that congregate insititution should has reasonable space when considering admitting residents. Moreover, most of the symptoms presented by the cases in the outbreak correspond to typical norovirus infection such as diarrhea and vomiting, it is then proposed that the institution to establish a daily syndromic surveillance for its residents (including the kitchen workers) for early detection of cases to prevention large-scale norovirus outbreaks [15].

Conclusion

Fifty-three cases were found in this norovirus outbreak which started from September 29 until October 7. The symptoms are mainly diarrhea and vomiting. Of the 50 fecal specimens taken from resisdents, 4 were tested positive for norovirus. To investigate the source of the outbreak, environmental samples were further collected, but only the toilet of room No.2 (3 residents) in Hsin 2 dorm where larger number of cases occurred on September 30 was found positive of norovirus. Therefore, it is determined that norovirus is the pathogen which caused this outbreak. But because of the fact that the fecal specimens collected from kitchen workers and the samples from the kitchen’s toilet and doorknobs were tested negative for norovirus, we are unable to determine whether the contamination source was from food or water. In view of the fact that a large scale norovirus diarrhea outbreak happened in this institution in 2007, it is still recommended that the institution implement

control measures such as having residents wash their hands, and strengthening the monitoring of all residents symptoms in order to avoid the recurrence outbreak. After symptomatic treatment, all cases experienced complete remission of diarrhea symptoms.

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