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Leptospirosis after Typhoon in Taiwan

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Background: Leptospirosis, an infectious disease that affects humans and animals, is a common zoonosis with a variety of clinical manifestations. Taiwan is one of the countries with a high incidence of leptospirosis. It is important to recognize the clinical features and risk factors of this disease. The aim of this study is to analyze the characteristics of patients with leptospirosis and correlate the onset of symptoms with exposure to a typhoon. **Methods:** We report 6 cases of serologically confirmed leptospirosis who required hospitalization during the past 5 years. The clinical characteristics, history of exposure to contaminated water and soil, and association with the occurrence of a typhoon were reviewed. **Results:** All patients were found to have a history of contact with contaminated soil or water. Five of these patients (83%) suffered from the disease just after a typhoon. Fever was the most common symptom in all cases (100%), followed by chills (83%) and myalgia (67%). Acute renal failure was the most common complication in these cases (83%), followed by jaundice (67%), acute respiratory failure (50%), and disseminated intravascular coagulation (33%). Jarisch-Herxheimer reactions were seen in three cases (50%). All cases were successfully treated with antimicrobial agents. **Conclusion:** Most (83%) patients suffered from leptospirosis after a typhoon. In order to prevent leptospirosis in Taiwan, it is important to educate the people on avoiding contact with contaminated water, moist soil, vegetation, and wearing protective clothing and footwear in areas suspected to be contaminated during the typhoon season. Educating the physicians on the early diagnosis of leptospirosis is also crucial in Taiwan.

Keywords: leptospirosis, typhoon

INTRODUCTION

Leptospirosis, one of the most common zoonotic infections worldwide, is caused by *Leptospira interrogans*[1]. Leptospires are gram-negative spirochetes that comprise 24 serogroups and 250 serovars[1]. The presentation of leptospirosis varies from asymptomatic to fever, chills, myalgia, and headache. Complications include chronic interstitial nephritis, mastitis, myocarditis, hemolytic crisis, and multiorgan failure[2].

The incidence of leptospirosis is higher in the tropics than in temperate regions[3]. Seasonal rainfall is significant risk factor for exposure to water contaminated with leptospires[4-6]. Leptospirosis is considered to be closely related to occupational and recreational exposure. Agriculture, mining, and military are considered high-risk occupations for leptospirosis[7-8], whereas swimming and canoeing are considered high-risk sports for leptospirosis[9-10].

Taiwan Island is located at the latitude of 23°N and has a subtropical climate. According to data on the prevalence of human leptospirosis from 1996 onwards, Taiwan has one of the highest incidences of leptospirosis in the world with an annual incidence of 4.1 persons per million[11]. Therefore, it is important to recognize the clinical features and risk factors of leptospirosis. The aim of this study is to analyze the characteristics of patients with leptospirosis in the past 5 years and correlate the onset of symptoms with the occurrence of a typhoon.

METHODS

We reviewed the medical records of all patients who had been diagnosed with leptospirosis on the basis of laboratory data from 2004 to 2008 in the Tri-Service General Hospital.

In this institution, patients suspected of having leptospirosis on the basis of typical symptoms and a history of

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possible exposure to contaminated water or soil were studied by two methods: culture isolation and serological diagnosis. Water or soil that may be contaminated with feces of infected animals was defined as contaminated water or soil. For *Leptospira culture*, blood was collected from the patients during the first 10 days of the onset of the disease, and urine was collected 10 days after the onset. Paired acute and convalescent sera were used for the microscopic agglutination test. One of the following two criteria were necessary for a positive laboratory diagnosis of leptospirosis: (1) culture isolation or (2) serological diagnosis by a four-fold rise in the titer between the acute phase and convalescent phase and a titer ≧ 1:400 for a single serum sample. Laboratory studies were performed at the Centers of Disease Control, Taiwan.

We obtained the following clinical information: history of exposure to contaminated water or soil, history of exposure to a typhoon before the onset of the disease, occupation, clinical signs and symptoms, and laboratory data.

Table 1 Demographic data, interval between disease onset and typhoon, and serovar of leptospires for 6 patients with leptospirosis

Case no.	Sex/yr	Occupation	Underlying diseases	Interval between disease onset and typhoon (days)	Name of typhoon	Serovar of leptospires
1	M /58	Business man	Thalassemia	27	Mitag	MAT/+/1600/Shermani MAT/+/800/Bataviae
2	F/69	Housekeeper	Nil	24 13	Wutip Sepat	MAT/+/3200/Shermani MAT/+/800/Bataviae
3	M/24	Soldier	Nil	9 7	Pabuk Wutio	MAT/+/1600/Shermani
4	M/23	Soldier	Nil	7 3	Hagupit Jangmi	MAT/+/800/Shermani MAT/+/3200/Bataviae
5	M/56	Retired Taxi driver	Nil	10 2	Sinlaku Hagupit	MAT/+/400/Shermani
6	M/20	Soldier	Nil	Nil	Nil	MAT/+/3200/Shermani MAT/+/3200/Bataviae

RESULTS

Six cases fullfiled the criteria for a laboratory diagnosis of leptospirosis. Most patients were male (83%); the average age was 42 years. The demographic data, clinical characteristics, and laboratory findings are shown in Tables 1 and 2. All patients were reported to have exposure to fresh water or soil that may have been contaminated with the feces of wild mammals. Three patients (50%) were in the army and had to perform regular outdoor exercises, which may have exposed them to contaminated soil. Fever was the most common symptom in all cases (100%), followed by chills (83%) and myalgia (67%). Acute renal failure was the most common complication in these cases (83%), and one patient underwent continuous venous-venous hemodialysis for two days, following which he recovered. Other complications included jaundice (67%), acute respiratory failure (50%), and disseminated intravascular coagulation (33%). Jarisch-Herxheimer reactions, characterized by rigors followed by hypotension, were seen in three cases (50%) after penicillin-G administration. All patients recovered after penicillin-G therapy without long-term complications.

The weather was found to be an important factor for contracting leptospirosis. In our study, five cases (83%) of leptospirosis developed just after a typhoon (Table 1).

In terms of the serovars, serological diagnosis revealed that four patients had been infected with both *Leptospira shermani and Leptospira bataviae*, and two patients by only Leptospira shermani (Table 1).

DISCUSSION

We studied six cases of leptospirosis. Of these, five patients developed the illness after the occurrence of typhoons. Each of these typhoons was accompanied with heavy rainfall. Typhoon-related floods maybe an important risk factor for leptospirosis in the typhoon season.

We thought that a history of contact with contaminated water or soil was an important risk factor for leptospirosis in all these six cases. Among them, three patients were army soldiers who had histories of contact with the soil as part of routine outdoor exercises. The high incidence of leptospirosis in army soldiers has been reported previously[8]. The other patients included a housekeeper, a business man, and a retired taxi driver who had histories of contact with contaminated water and soil due to a typhoon. Five patients contracted the disease after exposure to at least 1 typhoon. Three of them developed the disease within two weeks after exposure to a typhoon. Four patients had been exposed to two typhoons. Thus, typhoon-associated floods are considered an important risk factor for leptospirosis. The incubation period of leptospires is usually 5-14 days and may even be one month[12]. In patients exposed to two typhoons, both the typhoons may play an important role in

Table 2 Disease onset before admission, clinical characteristics, laboratory data, hospital days, and outcome of 6 patients with leptospirosis

Case No.	Disease onset before admission (days)	Clinical characteristics	Laboratory data	Hospital days (days)	Outcome
1	3	Fever, chills, myalgia jaundice, acute renal failure	D/T bilirubin: 11.5/16.2 mg/dL AST/ALT: 50/76 U/L BUN/Cr: 51/1.3 mg/dL	11	Survived without sequela
2	2	Fever, chills, acute renal failure requiring 2 days of hemodialysis acute respiratory failure	D/T bilirubin: 2.6/3.6 mg/dL AST/ALT: 50/76 U/L BUN/Cr: 181/10.5 mg/dL	12	Survived without sequela
3	5	Fever, chills, headache, abdominal pain, diarrhea, chest tightness, acute renal failure	AST/ALT: 55/36 U/L BUN/Cr: 32/3.2 mg/dL	12	Survived without sequela
4	7	Fever, chills, myalgia, jaundice, acute renal failure, thrombocytopenia	D/T bilirubin: 2.9/3.8 mg/dL AST/ALT: 345/180 U/L BUN/Cr: 43.75/3.8 mg/dL PLT: 58000/uL	9	Survived without sequela
5	3	Fever, chills, headache, myalgia, abdominal pain jaundice, acute respiratory failure	D/T bilirubin: 0.8/2.2 mg/dL AST/ALT: 40/68 U/L BUN/Cr: 22/1.2 mg/dL	6	Survived without sequela
6	4	Fever, chills, myalgia, abdominal pain, acute renal failure, myocarditis, acute respiratory failure, disseminated intravascular coagulation	AST/ALT: 66/41 U/L BUN/Cr: 46/4 mg/dL	12	Survived without sequela

Abbreviations:
BUN: blood urea nitrogen; **Cr:** creatinine; **AST:** aspartate aminotransferase; **ALT:** alanine aminotransferase; **D bilirubin:** direct bilirubin; **T bilirubin:** total bilirubin; **PLT:** platelet.

the infection. According to the data of the Centers of Disease Control of Taiwan, the highest prevalence of leptospirosis is observed from June to October. This correlates with the typhoon season in Taiwan. Leptospires may be shed by reservoir hosts, and accumulate from contaminated soil to rivers when the capacity of the soil to absorb moisture is exceeded during heavy rainfall. Thus, avoiding contact with soil and water that may be contaminated after a heavy rainfall is important to prevent leptospirosis.

The clinical spectrum of leptospirosis is broad, ranging from asymptomatic illness to the classical syndrome of Weil's disease. According to a previous study, fever is the most common symptom (100%) of leptospirosis, followed by chills (77.7-93%), myalgia (57-95.9%), headache (86-89%), conjunctival suffusion (52.9-57%), jaundice (54.5%), and acute renal failure (21.5%)[12,13]. The symptoms of our patients were similar to those observed in previous reports. The clinical manifestations are not pathognomic and may initially mimic many other conditions, notably including meningitis, hepatitis, acute pulmonary distress syndrome, and interstitial nephritis. The varied clinical presentation can be explained by the pathogenesis of the disease: leptospires frequently enter the body via skin abrasion or exposed mucous membranes, and spread through the bloodstream and tissues without initial inflammation. The acute or septicemic phase lasts for about one week without significant complications. It is followed by the immune phase, characterized by antibody production and excretion of leptospires in the urine. Vasculitis, endothelial damage, and inflammatory infiltrates composed of monocytic cells, plasma cells, histiocytes, and neutrophils develop in any tissue affected in this phase[2]. The clinical presentation reflects the secondary changes in the affected organs and the severity of the damage, although the great majority of infections caused by leptospires are subclinical[1]. In terms of the serovars, four patients were seropositive to both *Leptospira shermani* and *Leptospira bataviae*. According to a previous study, a cross-reaction in the microscopic agglutination test to leptospirosis is commonly observed in Asia and the Pacific region[14].

Although the number of cases in our study was limited and further large-scale studies may be required to support the correlation between typhoons and leptospirosis, the risk of exposure to contaminated water and soil that may harbor leptospires is increased during both typhoon-related floods and heavy rainfall in tropical countries. In conclusion, Taiwan has subtropical climate and is in high prevalence of leptospirosis. Our study suggested the association of typhoon and leptospirosis. In order to prevent leptospirosis in Taiwan, it is important for the education of people to avoid contact with contaminated water, moist soil and vegetation and to wear protective clothing and

footwear in areas suspected to be contaminated during the typhoon seasons. Education of physician on the early diagnosis is also of critical significance in Taiwan.

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