Case Report

Primary case of human pneumonic plague occurring in a Himalayan marmot natural focus area Gansu Province, China

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S U M M A R Y

A case of primary pneumonic plague (PPP) caused by Yersinia pestis is reported. This case occurred in the largest plague area in China. The patient died after contact with a dog that had captured an infected marmot. Three of 151 contacts were shown to be positive for antibody against F1 antigen by indirect hemagglutination assay, but none had clinical symptoms. There was no secondary case.

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1. Introduction

China has faced plague throughout history. With efficient prevention and control, human cases are significantly reduced; however sporadic cases still emerge.

The Qinghai-Tibet plateau natural plague focus area is the largest in China. The primary reservoir is the Himalayan marmot Marmota himalayana (and rodents), with annual outbreaks in animals occasionally spreading to humans. Capturing and flaying marmots is the main cause of human infection. With increased awareness, fewer people are flaying marmots and human cases are decreasing.

2. Case report

The index case was a 38-year-old male shepherd. On July 11, 2014, he seized a marmot from a dog while grazing sheep. His older brother then dismembered the marmot and fed the meat to five dogs, including the dog that had captured it. The man began to have a fever on July 13. On July 14, he went to Yumen City and talked with his sister-in-law and neighbours. His condition deteriorated rapidly on July 15 and he went to the village clinic. From there he was transferred to the local hospital where a preliminary diagnosis of upper respiratory infection was made; this was treated with anti-pyretics, anti-inflammatory agents, and clindamycin. However, his condition worsened and he was transferred to Yumen People’s Hospital.

Examinations showed a pathology of both lungs; he had a partially dilated intestine, pleural effusion in the left lung, and a pericardial effusion. The diagnosis of severe pneumonia was made and he was given anti-inflammatories, fluid replacement, and cefoperazone sodium. At 10:30 p.m., blood, sputum, and a throat swab were taken for serological tests and strain isolation. The serum was collected to determine the F1 antibody concentration via indirect hemagglutination assay (IHA). A reverse IHA was used to detect the Yersinia pestis F1 antigen from sputum and throat samples.

At 11:30 p.m. on July 15, sputum and blood smears showed a Gram-negative bacillus with rounded darker ends. The patient was...
diagnosed as a suspected plague case and was reported to the Infectious Disease Reporting System.

At 00:10 a.m. on July 16, the patient’s blood pressure decreased and he became short of breath and produced red frothy sputum. The breath was low in the left lung and there was a wet rattle in both lungs. He was treated with 1 g streptomycin intramuscular (IM), 8 mg gentamicin intravenous (IV), and dopamine. At 5:00 a.m., there were signs of dysphoria, polypnea, and cardiac arrest; he immediately received assisted respiration, external cardiac massage, and electric defibrillation. The patient died at 5:57 a.m. At 1:30 a.m. on July 16, antibody to F1 antigen was detected at a titre of 1:40 (serum); the reverse IHA showed titres of 1:6400 (throat) and 1:12800 (sputum). PCR for Y. pestis fra and pla was positive.6,7 On July 18, Y. pestis strains were isolated from sputum, blood, and throat swab samples,8 and identified by bacteriophage lysis test and PCR.

Experts including epidemiologists, bacteriologists, and doctors diagnosed the case as one of primary pneumonic plague (PPP).

Among 151 contacts, 63 were close contacts in the outpatient and inpatient departments and their escorts, and these contacts were immediately quarantined; the other 88 were indirect contacts and visitors, and they were isolated in their homes (Figure 1). Examination of paired sera of the 151 contacts using the IHA (on July 16 and 20) showed the sister-in-law to have an F1 antibody titre that increased from 1:16 to 1:64; two of the outpatients transfused in the same room had F1 antibody titres of 1:16. The remaining contacts were negative.

Five dogs fed with the marmot were positive for F1 antibody with titres of 1:32 (n = 1) and 1:128 (n = 4; including the dog that had captured the marmot). One dog that had not eaten the marmot was F1-negative.

Beginning on July 16, preventive medications were given to the 151 contacts: streptomycin IM (0.75 g on July 16) and oral sulfadiazine (2 g per day from July 17 to 21, in three doses per day). All contacts were quarantined for 9 days under professional medical observation. At 9 a.m. on July 17, the corpse and

![Figure 1. Epidemiology of the case of primary pneumonic plague (PPP).](image-url)
contaminated objects were sent to a biosafety disposal unit and the area of contamination was sterilized. The five dogs with F1 antibody were destroyed. Marmot depopulation was performed in the grazing location.

3. Discussion

This PPP index case died, and three of 151 contacts were positive for F1 without clinical symptoms. Because ineffective antibiotics were given, the PPP progressed before detection; therefore the patient missed the treatment window. The local village clinic and local hospital where the patient was misdiagnosed had limited medical facilities; Y. pestis was not identified until microscopic examination was performed. When streptomycin was used, large amounts of endotoxin entered the bloodstream leading to shock and a more rapid progression to death. This case suggests that early accurate diagnosis and the use of correct antibiotic treatment are of the highest importance for a plague patient. Doctors need to improve awareness and obtain a contact history to identify the possibility of plague infection in order to avoid misdiagnosis.

The case was initiated by a dog capturing an infected marmot. The primary cause of the PPP was exposure to Y. pestis aerosols because Y. pestis strains were isolated from sputum and throat samples.

This case occurred in Yumen County, Gansu Province, located in the Qinghai–Tibet natural plague area. Animal and human cases have recently been increasing; a case of human plague occurs almost every year (Table 1). There have been two human plague cases reported in Yumen County. The epidemic risk has recently become higher. In 2012, the isolation of Y. pestis from dead marmots was 1.94% and from fleas was 4.17%, and an average 4.55% of dogs were positive for F1 antibody. In 2013, the isolation was higher: 40.7% and 3.74% for dead marmots and fleas, respectively, and 10% of dogs F1 antibody-positive. From May 5 to July 11, 2014, 13 Y. pestis isolates were obtained from 27 dead marmots, a rate of 48.15%.

Grassland dogs are ferocious predators, especially for infected rodents that are less active. In the case reported here, all of the dogs that ate the marmot were infected with Y. pestis without symptoms. The dogs that ate the marmot showed the presence of F1 antibody, however the one that did not eat the marmot was negative. Dogs are used as an indicator animal for plague surveillance, and measuring the antibody to F1 in dog serum can predict the plague outbreak risk. In the Qinghai–Tibet plague focus area, 25.71% (27/105) of dogs were found to be positive for F1 antibody in Gansu Province and 18.18% (22/121) in Qinghai Province.

All contacts underwent on-site isolation and all were under medical observation and took prophylactic medication. Three clinically asymptomatic contacts had F1 antibody, but there were no secondary cases. This shows that prophylactic medication can efficiently control the spread of plague. In contrast, in the PPP outbreak reported in 2009 in Qinghai Province, all 11 close contacts were infected as no efficient timely control occurred.

F1 antibody was detected in people who had been in contact with the patient for a long period of time: the sister-in-law and two outpatients who had undergone infusions at the same time as the case patient. Contamination may depend on the duration of the exposure. However, the older brother-in-law who dismembered the marmot and the patient’s wife who accompanied him until his death were negative for F1 antibody. We found that better health may effectively prevent PPP among contacts. In addition, no F1 antibody was detected in the serum of the doctors and this may be related to the wearing of masks. This simple countermeasure may provide a basic form of defence when facing unknown risks for infection.

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References


