

Outbreak Reports

Brucellosis Outbreak Caused by *Brucella melitensis* — Jingyang County, Shaanxi Province, China, March–May, 2020

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Summary

What is already known about this topic?

Brucellosis is one of the world's most overlooked zoonotic diseases, and humans can easily acquire brucellosis from animals and their products. Reemerging brucellosis outbreaks are probably attributable to sociocultural factors and compounded by the lack of adequate control measures in sheep and goat rearing systems.

What is added by this report?

This is the first identified outbreak caused by *Brucella melitensis* bv.3 in Jingyang County, Xianyang City, Shaanxi Province. A total of 13 seropositive cases (7 acute patients and 6 asymptomatic persons) were identified from March to May, 2020, and the investigation indicated that sheep-to-canine-to-human was the likely transmission route.

What are the implications for public health practice?

Effective control of sheep brucellosis will significantly reduce the risk of human brucellosis. Priority should be given to building cooperation between all stakeholders, maintaining epidemiological surveillance to detect human brucellosis at medical centers, and making case reporting mandatory for both veterinary and public health services.

From April 29 to May 1, 2020, a brucellosis outbreak was reported in a village in Jingyang County, and as of May 7, 7 symptomatic cases and 6 asymptomatic cases were detected and reported. The investigation on this outbreak was conducted by the Jingyang County CDC and Livestock Center and revealed that Patient 1 and her eight relatives were exposed to their infected dogs, which might have been infected by the pathogen when they ate miscarried lambs that had been buried in the orchard of Patient 10. Patient 10 and the 3 individuals (Patient 11, 12 and 13) with positive test results were infected by contact with their sick sheep. In addition, four

suspected *Brucella* strains (two from infected sheep and two from patients) were isolated and identified by a classical phenotyping method (1) and Abortus, Melitensis, Ovis, and Suis polymerase chain reaction (AMOS-PCR), as described elsewhere (2). MLVA-16 (multiple-locus variable-number tandem repeat analysis) was also performed for epidemiological tracing (3).

INVESTIGATION AND RESULTS

Suspected cases were defined as residents of the village and neighbouring villages who developed 2 or more of the following symptoms from March 1 to May 7, 2020: fever (≥ 37.5 °C), fatigue, night sweats, and joint pain excluding patients with confirmed diagnosis for other diseases. Confirmed cases were defined as suspected cases with an antibody titer of $\geq 1:100$ (++) in serum agglutination test (SAT) or positive *Brucella* isolate according to the guidelines for the Diagnosis of Human Brucellosis (WS 269–2019).

So far, out of the 279 individuals who were tested, 13 met the criteria for diagnosis. The demographic and clinical data of individuals who tested positive during the brucellosis outbreak in the village were shown in Table 1. Among the 13 individuals with positive test results, there were 8 males and 5 females (male to female ratio, 1.6:1). Their ages covered a wide range of 2 to 64 years. Interestingly, 9 of the individuals (Patients 1–9) were related to each other. Most of the cases were found in the family of Patient 1. Among the 3 asymptomatic individuals, 2 individuals were from the East Third Unit (Patients 11 and 12), and 1 was from the Z Group of the village (Patient 13). They were all sheep farmers and had a history of contact with a sheep that had a miscarriage. They did not live in the same village as the others who tested positive.

Patient 1 and her relatives (nine individuals in total) had no history of drinking cow and goat milk and no history of contact with any lamb. The family of Patient 1 currently had 2 dogs, which were sometimes tethered

TABLE 1. List of individuals who tested positive during the outbreak of brucellosis in Jingyang County, Shaanxi Province, China, 2020.

No.	Sex	Age (years old)	Occupation	Case relationship	Results of SAT	Date of onset	Time of diagnosis
1	Female	46	Beef cattle farmer	Initial case	1:800 (+++)	Mar 18	Apr 28
2	Male	15	Student	Nephew	≥1:800 (++++)	Apr 26	May 1
3	Male	24	Farmer	Son-in-law	1:200 (+++)	Apr 23	May 1
4	Female	2	Scattered child	Granddaughter	1:400 (+++)	Apr 26	May 1
5	Female	24	Farmer	Daughter	≥1:800 (++++)	May 1	May 1
6	Female	10	Student	Niece	1:800 (+++)	Apr 14	May 5
7	Female	20	Student	Niece	1:400 (++)	Apr 1	May 5
8	Male	47	Beef cattle farmer	Husband	1:800 (+++)	No symptom	–
9	Male	62	Farmer	Case 8's older brother	1:800 (++)	No symptom	–
10	Male	64	Sheep farmer	West No. 2	1:100 (++)	No symptom	–
11	Male	75	Sheep farmer	East No. 3	1:200 (++)	No symptom	–
12	Male	60	Sheep farmer	East No. 3	1:200 (+++)	No symptom	–
13	Male	67	Sheep farmer	Z Group	1:400 (+++)	No symptom	–

Abbreviation: SAT=serum agglutination test.

and sometimes let outside their cage, and Patient 1's husband once fed a stray dog. Starting in 2018, the family raised beef cattle in their backyard under poor sanitary conditions. Patient 1's husband was responsible for feeding the cattle, but he did not use any protective measures during the feeding process. Jingyang County's Livestock Center collected blood samples of 10 cattle that belonged to Patient 1, but the test results were negative for all cattle samples. All the individuals who visited Patient 1's family in her village were investigated, and the results showed that the visits were associated with disease onset. On May 5, the Livestock Center collected blood samples from the two dogs that belonged to Patient 1 and her family, and both tested positive for brucellosis. Given all cases had a suspected exposure to dogs, we concluded that contact with the dogs was a key risk factor of infection.

The family of Patient 10 had 2 long-term residents and live only 2 households away from Patient 1 and her family. Patient 10 had been raising sheep for 10 years by self-breeding and had not purchased any other sheep. By the end of 2019, they had 4 pregnant sheep, two of which miscarried, and the fetuses were buried in their own orchard. However, the miscarried fetuses later disappeared from the burial spot, and it was suspected that they had been taken away by an animal. The family of Patient 10 had 2 lambs in stock, and both tested positive in tests done by the Livestock Center on April 30 indicating that these 2 lambs were the source of infection.

On May 5, the Livestock Center collected samples

from 70 sheep in stock at another possibly infected sheep farm in the village, and 4 sheep tested positive. On the same day, Jingyang County CDC collected samples from four employees of the sheep farm and all of them tested negative.

The results of epidemiological investigation and comprehensive analysis indicated that the brucellosis outbreak in Patient 1's family and the eight relatives was caused by exposure to their infected dogs that were likely exposed due to consuming miscarried lambs buried in Patient 10's family orchard. Patient 10 and 3 individuals with positive test results in the other groups were infected by contact with their sick sheep. All 4 isolates (2 isolates from sheep belonging to Patient 10 and 1 each from Patient 7 and Patient 11) were identified *B. melitensis* bv. 3 and showed an identical MLVA profile (1-5-3-13-2-2-3-2-4-40-8-6-4-3-4-5), suggesting the same exposure source.

PUBLIC HEALTH RESPONSE

During this investigation in May 2020, multiple emergency countermeasures were taken including case searching, diagnosis and treatment of patients, health education, tracing the sources, and disinfecting contaminated environments. Up to May 7, 252 blood samples were collected from sheep and 65 were collected from cattle by the Livestock Center, and only 25 blood samples from sheep tested positive. The Jingyang County CDC screened all high-risk populations, and a total of 279 individuals were tested.

A total of 7 patients were hospitalized in the Eastern Suburb Branch of Xianyang Central Hospital, and 6 asymptomatic persons were under medical observation at home. Based on this investigation, all stakeholders took long-term joint actions including promoting information dissemination and health education on brucellosis, cracking down on illegal activities related to aborted and sick animals, etc.

DISCUSSION

In this study, aborted sheep fetuses and close contact with infected dogs were found to be the key risk factors for human brucellosis, and aborted fetuses, placentas, and secretions were already known to be one of the most infective sources of *Brucella* species (4). However, although *Brucella* is easily transmitted among domesticated animals, such as cattle, goats, and sheep (5), the role of close contact with dogs is often ignored in the development and implementation of prevention and control strategies. Stray dogs are generally assumed to be able to contribute to the distribution and retention of *Brucella* spp. in dog populations (6). Literature considers the zoonotic potential of *B. canis* is low compared to *B. melitensis*, *B. suis*, and *B. abortus*, which are more frequently reported as the underlying cause of human brucellosis (7). Less attention has been paid to *B. canis* in China, although dogs usually live in close contact with their owners, and breeding for commercial purposes in poor housing conditions without veterinary care may constitute additional risks. Therefore, dogs should be prohibited from eating aborted sheep fetuses in rural areas, especially in endemic regions.

In case of an outbreak in the future, genome-based epidemiological tracing should be performed. Recently, whole-genome shotgun (WGS) for bacterial pathogens has become cheaper and faster, and bioinformatics analysis based on the WGS is crucial for both epidemic and outbreak investigations (8–9). In this study, the isolate from Patient 11 was of the same phenotype as that identified in Patient 7, but Patient 11 did not report any significant clinical symptoms. It is unclear whether the isolate had low virulence or the incubation period was longer.

Based on this outbreak investigation, infected animals should be promptly isolated, culled, and buried. Additionally, farmers should also receive guidance regarding performing daily disinfection of the family and livestock breeding environments. Importantly, regular screening of livestock farms and

families must be undertaken. Local CDC's and Livestock Centers should conduct active surveillance of brucellosis among humans or animals, collect and analyze the epidemiological data on brucellosis, and carry out risk assessments to guide its prevention and treatment (10). Cooperative actions such as simultaneous monitoring, information exchange, complementary measures by various departments, and resource sharing should be included to formulate a practical monitoring and prevention strategy (11). Health education and consulting services should be provided to spread information about the prevention and treatment of brucellosis, to improve awareness regarding self-protection, and modify unhealthy production methods and lifestyles. Farmers should be actively guided to implement scientific feeding methods and strengthen personal protection by providing effective protective equipment.

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