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, 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 ≥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...
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 (1-5-3-13-2-2-3-4-40-8-6-4-3-4-5), 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.

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

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

Abbreviation: SAT=serum agglutination test.
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 \(^8\text{–}^9\). 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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