

Human Brucellosis Outbreak Acquired through Camel Milk Ingestion in Southern Israel

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ABSTRACT: **Background:** Human brucellosis is common in southern Israel among the semi-nomadic Bedouin, a population that consumes unpasteurized dairy products. Though camel milk ingestion is a known mechanism for brucellosis acquisition, only a few reports of sporadic cases have been published in the medical literature.

Objectives: To describe a local brucellosis outbreak in 15 extended Bedouin family members, following ingestion of infected camel milk.

Methods: Data regarding patient's clinical manifestations, laboratory findings, treatment and outcome were collected from the hospital and the health fund clinics' computerized database. Camel's blood and milk were tested for *Brucella* serology and culture. Cases were defined by positive Rose Bengal test, symptoms correlating with brucellosis, and consumption of infected camel milk.

Results: Fifteen patients were diagnosed with acute brucellosis from March to June 2011. Sixty percent of cases had serum agglutination test titers of 1:160 or higher and 4/8 (50%) had positive blood culture for *Brucella melitensis*. Arthralgia and fever were the most consistent clinical manifestations. Blood and milk serology and milk culture taken from the female camel were positive for *Brucella melitensis*.

Conclusions: The treating physicians must consider the possibility of infected camel milk ingestion as the mode of infection, both in sporadic cases and in outbreaks of brucellosis.

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KEY WORDS: brucellosis, camel milk, outbreak, *Brucella melitensis*

Brucellosis is a common zoonosis around the world, affecting humans and several domestic animals including sheep, goats, cows and camels. The main sources of infection are food-borne, usually through the consumption of contaminated dairy products, and occupational exposure, occurring in veterinarians or abattoir workers [1]. Human

cases of brucellosis acquired by camel milk ingestion have been reported only sporadically and never in Israel [2-8].

Brucella melitensis infections are common in southern Israel among herds of sheep and goats and cause substantial human morbidity in the semi-nomadic Bedouin population of the area that consumes unpasteurized dairy products [9]. We report a local brucellosis outbreak in 15 extended Bedouin family members following ingestion of infected camel milk.

PATIENTS AND METHODS

In June 2011, three siblings were hospitalized with brucellosis in the pediatric department of the Soroka Medical Center. All children complained of prolonged fever (> 1 month) and one child reported weakness and arthralgia. Family history revealed that a sibling, a father and a grandmother had been diagnosed with brucellosis 1 week, 2 weeks and 2 months earlier, respectively.

Since laboratories in Israel are required by law to report all cases of brucellosis to the Ministry of Health, we decided to conduct an epidemiologic survey to discover the outbreak source. Further investigation by questioning family members and their primary physician revealed an additional nine symptomatic family members. Overall, 15 patients were identified. The infected family had raised a female camel and a camel calf during the previous 7 months, believing that camel milk has a beneficial health effect for the family.

The family lives in a closed compound (surrounded by a fence) that contains four houses; the two camels were held in an adjoining backyard. Only family members living in this compound had direct contact with the camels, but unpasteurized camel milk was consumed by most family members (all infected cases).

We collected patient data from the hospital and the health fund clinics' computerized database. These included data regarding patients' complaints (fever, arthralgia, weight loss and weakness), clinical manifestations (fever, hepatosplenomegaly), laboratory findings (*Brucella* serology, including the

Rose Bengal test, immunoglobulin M and G, blood cultures, hemoglobin, leukocytes, thrombocytes and liver enzymes) and outcome (hospitalization). Data regarding the camels' serology and cultures were obtained from the brucellosis laboratory, Kimron Veterinary Institute, Beit Dagan.

Sera from all cases were screened for *Brucella* antibodies by the Rose Bengal test [10]. Positive specimens were serially diluted from 1:20 up to 1:1280 and tested by the standard agglutination test [11]. Blood cultures were obtained, using the Bactec 9240 system (Becton Dickinson, Cockeysville, MD, USA), within 48 hours of the serologic tests, as reported before [12]. All blood cultures were incubated for 7 days. The camel bloods were tested for *Brucella* by three conventional serological methods: RBT, complement fixation and serum agglutination tests. Camel milk samples were tested by the milk ring test and cultured bacteriologically [13]. The strains isolated were further characterized by phage typing and biochemical tests. The sero-agglutination test of the strains by anti-A and anti-M monospecific sera was used in the biotyping of the *Brucella* isolates [13]. Cases were defined by a positive RBT, symptoms correlating with brucellosis of either fever or arthralgia, and consumption of infected camel milk.

RESULTS

Outbreak description

Between March 2011 and June 2011, 15 Human cases of brucellosis were identified. Ten were children (age range 1–15 years) and 5 were adults (33–61 years), all members of one extended family [Table 1].

The first two patients had been symptomatic since March 2011, a third patient became symptomatic in the first week of June, and 2 weeks later three children were hospitalized due to symptoms correlating with brucellosis. All patients had a positive RBT and in 9 cases (60%) IgM titers were positive ($\geq 1:160$). IgG titers were identical to the IgM titers in all 15 patients.

Blood cultures were taken from eight patients and in four cases *Brucella melitensis* biotype 1 was grown (overall seven positive cultures: two in three patients and one in one patient). All positive isolates were grown within 96 hours of sampling.

The female camel blood tested positive on the RBT, complement fixation test (1:320) and serum agglutination test (1:1280). Camel milk tested positive on the milk ring test. *Brucella melitensis* biotype 1 grew in milk culture. Serologic tests of the camel calf were negative for *Brucella*.

Following these results, the female camel was slaughtered and the camel calf, which tested negative for *Brucella*, was confiscated by the Ministry of Agriculture.

RBT = Rose Bengal test
IgM = immunoglobulin M

Clinical manifestations

Arthralgia (13/15) and fever (12/15) were the most consistent clinical manifestation. Weakness (3/15), diarrhea, vomiting and abdominal pain (4/15), cough and shortness of breath (3/15), rash (1/15) and night sweats (1/15) were also reported. Hepatosplenomegaly was not reported.

Laboratory findings

Elevated liver enzymes (alanine or aspartate aminotransferase > 35 U/L) were noted in six of the eight patients and anemia (hemoglobin < 12 g/dl) in three of seven cases. None of the patients had leukocytosis, leukopenia or hyperbilirubinemia.

Treatment regimens

Data regarding treatment were available for 13/15 cases. Children < 8 years old (four cases) were treated with co-trimoxazole and gentamicin. Children > 8 years old (five cases) were treated with doxycycline and gentamicin (two cases), doxycycline and streptomycin (two cases), or co-trimoxazole and gentamicin (one case).

Adults > 18 years old (four cases) were treated with doxycycline and streptomycin (three cases), except for a pregnant patient who was treated with co-trimoxazole.

Outcome

Six patients (40%) were hospitalized for 2–7 days and were treated with antibiotics, without any other interventions [Table 1]. During 3 months of follow-up there were no cases of mortality.

DISCUSSION

Transmission of brucellosis to humans can occur through the consumption of infected unpasteurized camel milk, but only a few reports, all of sporadic cases, were published in the medical literature [2–8].

This report, describing a local human brucellosis outbreak, emphasizes the importance of awareness that ingestion of unpasteurized camel milk can serve as a mode of infection. The Bedouin population of southern Israel is at increased risk for acquiring brucellosis due to frequent contact with domestic animals and ingestion of unpasteurized animal milk.

The incidence rate of brucellosis in the Bedouin population in southern Israel was 49.4/100,000 in 2009 compared to the 1.8/100,000 nationwide incidence rate (Ministry of Health data). The high incidence rate of brucellosis in the Bedouin population could be attributed to lack of awareness regarding the nature of disease, modes of transmission and prevention methods.

Between 1998 and 2001, the local office of the Health Ministry initiated an educational community-based program aimed to increase awareness in the Bedouin population

Table 1. Demographic and clinical manifestations

Patient no.	Age (yrs)	Gender	Hospitalization	Rose Bengal test	Brucella IgM titer	Blood culture	ALT (U/L)	AST (U/L)	Treatment	Clinical manifestations
1	61	Female	Yes	Positive	1:20	Positive*2	63	60	Doxycycline + streptomycin	Fever, arthralgia, weakness, dyspnea
2	33	Male	No	Positive	1:160	None	NA	NA	NA	Fever, arthralgia
3	6	Female	Yes	Positive	1:640	Positive*1	58	87	Co-trimoxazole + gentamicin	Fever, arthralgia, loss of appetite, vomiting
4	1	Female	Yes	Positive	1:160	Negative	21	49	Co-trimoxazole + gentamicin	Fever, diarrhea
5	11	Male	Yes	Positive	1:160	Negative	25	34	Doxycycline + gentamicin	Fever, arthralgia, weakness
6	1	Female	Yes	Positive	1:320	Positive*2	33	60	Co-trimoxazole + gentamicin	Fever
7	36	Male	No	Positive	1:1280	None	58	44	Doxycycline + streptomycin	Fever, arthralgia
8	14	Male	No	Positive	<1:20	None	NA	NA	Doxycycline + streptomycin	Arthralgia
9	10	Male	No	Positive	1:640	Positive*2	NA	NA	Doxycycline + gentamicin	Fever, arthralgia, weakness, rash, cough, night sweats
10	6	Female	No	Positive	< 1:20	None	NA	NA	Co-trimoxazole + gentamicin	Arthralgia
11	15	Male	No	Positive	< 1:20	None	NA	NA	Doxycycline + streptomycin	Fever, arthralgia
12	38	Female	Yes	Positive	1:80	Negative	25	31	Co-trimoxazole	Arthralgia, cough, abdominal pain, pregnancy
13	38	Male	No	Positive	1:320	Negative	76	43	Doxycycline + streptomycin	Fever, arthralgia, headache
14	10	Female	No	Positive	1:320	None	NA	NA	Co-trimoxazole + gentamicin	Fever, arthralgia, diarrhea
15	12	Female	No	Positive	<1:20	None	NA	NA	NA	Fever, arthralgia

ALT = alanine aminotransferase, AST = aspartate aminotransferase, NA = not available

of the nature of disease, modes of transmission, and prevention methods including livestock vaccination. Evaluation of this program demonstrated a significant increase in the population’s knowledge about brucellosis and its prevention methods, but there were no positive behavior changes (e.g., avoiding unpasteurized animal milk and not wearing gloves when in contact with animals).

Camels are highly susceptible to brucellosis caused by *Brucella melitensis* and *Brucella abortus*, but this disease provokes only a few clinical signs in camels in contrast to its clinical course in cattle [14]. Furthermore, the greatest risk of *Brucella* transmission was associated with products derived from sheep as opposed to camels [7]. This could explain the low prevalence of brucellosis attributed (by both the Bedouin population and physicians) to camel milk consumption.

The diagnosis of brucellosis relies mainly on serology. A positive RBT could be attributed to previous exposure to *Brucella* and not necessarily to recent infection. To avoid ‘over-diagnosis’, IgM titers of $\geq 1:160$ are considered diagnostic [15]. We found one patient with two positive blood cultures for *Brucella melitensis* and low antibody titers, thus proving confirmed brucellosis with false negative serology. This patient was symptomatic 2 months before blood tests

were performed. This suggests that a combination of epidemiologic and clinical findings should be used for brucellosis diagnosis, even in serological “unproven” cases.

Conclusions

The treating physician should consider the possibility of infected camel milk ingestion as the mode of infection, both in sporadic cases and in outbreaks of brucellosis.

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