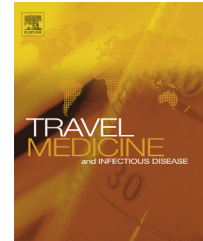


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Invasive human brucellosis infection in travelers to and immigrants from the Horn of Africa related to the consumption of raw camel milk

Q6 Heather M. Rhodes^a, David N. Williams^{a,b}, Glen T. Hansen^{a,b,*}

^a Hennepin County Medical Center, 701 Park Avenue, Minneapolis, MN 55415, United States

^b University of Minnesota, Minneapolis, MMC 196, 420 Delaware St, SE, Minneapolis, MN 55455, United States

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Summary *Background:* Brucellosis is the commonest zoonosis worldwide and typically results from ingestion of unpasteurized goat and sheep milk and cheese. Consumption of camel milk is common in the Middle East and the Horn of Africa, but is an infrequently reported source of brucellosis.

Methods: We report three immigrant patients seen in one hospital system between 2007 and 2013 with brucellosis due to the consumption of camel milk.

Results: The case patients presented after 3–14 days of symptoms following travel to countries where Brucella is endemic. All three patients were bacteremic. One patient had definite infective endocarditis, one had possible endocarditis and one patient presented with acute brucellosis. The diagnoses were made expeditiously and appropriate treatment initiated.

Conclusions: Knowledge of travel, local customs and immigration patterns are keys to early Brucella diagnosis and optimal treatment. Previous reports implicating camel milk as the source of Brucella infection have been limited to patients living in or traveling to and from the Middle East. This report highlights the acquisition of Brucella infection in travelers to and immigrants from the Horn of Africa related to the consumption of camel milk.

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* Corresponding author. Department of Microbiology, Hennepin County Medical Center, 701 Park Avenue, Minneapolis, MN 55415, USA.
E-mail addresses: heather.arnold.1@gmail.com (H.M. Rhodes), dainevw43@gmail.com (D.N. Williams), glen.hansen@hcmcd.org (G.T. Hansen).

1. Introduction

While brucellosis remains the commonest zoonosis worldwide, its incidence in the United States (US) and Western Europe has declined over the last five decades due to public health measures including animal vaccination and dairy product pasteurization. Historically, brucellosis transmission was the result of direct animal contact; however, most present-day infections occur from consuming unpasteurized milk and cheese [1].

Brucellosis has a worldwide distribution with the highest incidence reported in Syria, Iran and Turkey. There are few reliable repositories for its incidence in Somalia, Ethiopia and other countries in the Horn of Africa. Several recent publications on brucellosis address its changing epidemiology as well as the importance of the travel and immigration history of patients with new onset fever [2–4].

African immigration to the US and Western Europe has increased since 1950 and dramatically so since 1990 [5,6]. Immigrants from the Horn of Africa are usually refugees, forced to leave their country because of civil war, drought and famine. Immigrants from Somalia have found new homes in the US, the United Kingdom, Sweden and elsewhere. Minnesota has the largest Somali population and the third largest Ethiopian population in the United States.

This report underscores the importance of dairy products including camel milk as a source of brucellosis in travelers to and from the Horn of Africa. The diagnosis is facilitated by a careful review of the patient's history as it relates to travel and food consumption. Brucellosis may not only be more difficult to diagnose if it is not considered early in the disease process but delay is more likely to lead to increased rates of focal complications [7]. The Horn region has the largest concentration of camels in the world and are an important source of milk, food and transport to the region's nomadic people. Camel milk is often consumed raw and is thought to have unique nutritious and therapeutic properties.

2. Materials and methods

We present data on three patients seen in one hospital system between 2007 and 2013 where consumption of camel milk was the likely source of *Brucella* infection.

3. Results

Patient 1: A previously healthy 23-year-old female returned to Minneapolis, Minnesota, after a two-month visit to her native Djibouti; she received no pre-travel counseling. Soon after her return, she complained of malaise, fever, and diffuse aches for one week followed by three days of left upper quadrant pain. In the emergency department she had a temperature of 39 °C. Clinical examination was normal apart from tenderness over the left chest and left upper abdomen. Subsequent evaluation included a chest CT scan, due to concern for a possible pulmonary embolism, which identified a splenic infarct but was otherwise negative. The splenic finding prompted a transthoracic echocardiogram (TTE) which showed no valvular abnormalities. Laboratory

tests were notable for a white blood cell count of 4400/cm², platelets of 63,000/cm² and mildly elevated transaminases.

Given concerns for a systemic infection, blood cultures were drawn and empiric intravenous (IV) ceftriaxone 2 g daily was initiated. On the fourth day of blood culture incubation, 3 of 3 blood culture sets returned positive with Gram-negative coccobacilli. This raised concern for brucellosis and blood culture isolates were later confirmed as *Brucella melitensis*. The constellation of multiple positive blood cultures for *Brucella* and the finding of a splenic infarct, raised the possibility of infective endocarditis, however, a transesophageal echocardiogram (TEE) was not performed for unknown reasons. The patient met one major and two minor Duke criteria, thus had insufficient evidence for definite infective endocarditis [8]. Parenteral treatment with gentamicin 3 mg/kg/day every 24 h and doxycycline 100 mg every 12 h resulted in clinical improvement after five days of therapy. No other symptoms or signs of infective endocarditis were found and combination therapy with oral doxycycline 100 mg every 12 h and rifampin 300 mg/day was initiated for a six week course. Of note, the patient initially denied consumption of dairy products but after further review later recalled using camel milk in her tea. The patient was seen in clinic 3 weeks following hospital discharge at which time no additional blood cultures were found to be positive. She was then lost to follow up. See Tables 1 and 2.

Patient 2: A previously healthy 30 year old Somali man who had immigrated to the US from Ethiopia two weeks prior to admission, presented with a 10 day history of fever, right upper quadrant pain, nausea, and vomiting. On admission he had a temperature of 39.2 °C, a grade three early diastolic murmur of aortic insufficiency and diffuse abdominal tenderness. Transthoracic and TEE confirmed an aortic valve vegetation and on day 3, three blood culture sets were positive for Gram-negative coccobacilli, later verified as *B. melitensis*. The patient's risk factors included frequent consumption of camel milk as well as periodic goat milk.

The patient was treated with 5 mg/kg/day intravenous gentamicin, oral rifampin 600 mg daily and doxycycline 100 mg every 12 h for one week, followed by a planned regimen of doxycycline and rifampin at the same doses for an additional three months. However, after only four weeks of treatment the patient declined further therapy despite detailed discussion with him and his wife using a professional interpreter, and a consultation with a Somali patient advocate. He agreed to outpatient follow up and at one and six months his physical examination, laboratory studies and TEE findings were unchanged. He had no peripheral stigmata of infective endocarditis and no evidence of heart failure. Follow up blood cultures remained sterile.

Patient 3: A 41 year old Ethiopian man with type II diabetes controlled with oral hypoglycemic agents was seen in the hospital's outpatient clinic after returning from a four month visit to Ethiopia and Somalia visiting family and friends. During his travels, he had consumed unpasteurized camel and goat milk and became ill while in Ethiopia with fever, chills, night sweats, abdominal pain and headache. His physical examination was unremarkable and his body

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