

Prospective Evaluation of 140 Patients With Brucellosis in the Southern Region of Turkey

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Abstract: The aim of this study was to assess the epidemiological, clinical, and laboratory characteristics of brucellosis in Adana region, Turkey. In this prospective study, a total of 140 patients with brucellosis were investigated in terms of spread of infection; seasonal, age, and sex distribution; clinical and laboratory characteristics; depression and anxiety rates; relapse rates; and response to different treatment combinations. One hundred two patients (72.9%) were female, and 38 patients (27.1%) were male; mean age was 45.81 ± 15.62 years, ranging from 2 to 77 years. Twenty-five patients (17.8%) had history of contact with animals, and 31 patients (22.1%) had history of consumption of raw milk and/or its products. The highest seasonal distribution was observed during summer. Malaise (95.0%), sweating (85.7%), and arthralgia (85.0%) were the major presenting symptoms. The most common physical examination findings were fever (52.9%), hepatomegaly (20.7%), and splenomegaly (12.1%). Osteoarticular involvement, orchitis, and iridocyclitis were observed in 64.9%, 38.0% (of male patients), and 0.7% of the patients, respectively. Scintigraphy was performed for 114 patients who have focal joint and bone complaints and findings. Beck Depression Inventory and State-Trait Anxiety Inventory testing were applied to 98 patients with brucellosis, and depression was observed in 37.8% of these patients. The total point of State Anxiety Inventory testing was 46.21 ± 12.87 , and the total point of Trait Anxiety Inventory testing was 46.98 ± 10.11 . Either the depression rates or points of State Anxiety Inventory testing and Trait Anxiety Inventory testing in patients with brucellosis were statistically higher than in the control group. In 134 patients, initial standard tube agglutination testing titer was 1/160 or more. *Brucella melitensis* was found positive in 22 patients. Relapse rate was 3.5%. Brucellosis continues to be a health problem in countries where consumption of unpasteurized dairy products and stockbreeding are common.

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Brucella species are small, nonmotile, non-spore-forming, unencapsulated gram-negative coccobacilli.¹ There are 7 species, of which only 4 can cause human brucellosis: *Brucella abortus*, *Brucella melitensis*, *Brucella suis*, and

Brucella canis.² Brucellosis occurs worldwide, with high endemicity in areas such as the Mediterranean countries, the Arabian Peninsula, Latin America, and Asia. Humans are infected by direct contact with infected animals or their products or, indirectly, by ingesting infected milk or dairy products. Following infection, microorganisms are ingested by neutrophils within which they are replicated. The infection spreads hematogenously to tissues rich in elements of the reticuloendothelial system such as liver, spleen, and bone marrow.^{1–4} The symptoms of brucellosis are characterized by high fever, sweat, malaise, anorexia, headache, and arthralgia. Depression and mental inattention are common complaints. The diagnosis depends on isolation of microorganisms from cultures of blood, bone marrow, and other tissues or detection of specific antibodies of *Brucella* compatible with clinical findings.² The purpose of this study was to evaluate a total of 140 patients with brucellosis in aspect of their epidemiological, clinical, and laboratory characteristics.

MATERIALS AND METHODS

Between December 2000 and August 2002, 140 patients with brucellosis admitted to Adana Medical Centre of Başkent University were investigated prospectively. Ninety-one of the patients enrolled to the study were referred from rural areas, and 49 were from urban areas. The study included all the patients admitted to the hospital during the study period. The investigation comprised a detailed history of consumption of raw milk and/or milk products, contact with animals, sex, age, and occupational and seasonal distributions of the patients. General physical examination, radiographic studies, and laboratory testing of all patients were performed. In addition, Beck Depression Inventory (BDI) and State-Trait Anxiety Inventory (STAI) testing were applied for 98 patients with brucellosis. As described previously,⁵ BDI includes 21 self-evaluating sentences relating to depression symptoms such as hopelessness and irritability, cognitions such as guilt or feelings of being punished, and physical symptoms such as fatigue and weight loss. Each item on the questionnaire takes points ranging from 0 to 3, and the total was obtained by summing those points. The total point would be 0 at minimum, 63 at maximum. The reliability and validity of the Turkish version were tested by Hisli⁶ who accepted threshold points of 17. We used the same threshold points in our study as well. Scores from 0 to 17 indicate that a person is not depressed; scores from 18 to 63 indicate that a person is depressed.

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STAI was developed by Spielberger et al⁷ for patients older than 14 years and conscious ones who can read and respond. This test is designed to measure an individual's characteristic tendency to experience anxiety when faced by threatening or challenging events. The inventory involves 2 subunits: (1) state anxiety criterion verifies how an individual feels in particular cognitions and time periods [State Anxiety Inventory (STAI-I) testing]; (2) trait anxiety criterion verifies how an individual feels when free of the situations and conditions [Trait Anxiety Inventory (STAI-II) testing]. Each subunit contains 20 items, and each item is scored from 1 to 4. Scores range from 20 to 80, with higher scores reflecting greater anxiety. The validity of the inventory for Turkish people was tested by Öner.⁸ These tests were also applied to control groups. The control population was chosen from an age-matched control group of healthy people where sex, educational status, and socioeconomic status were all adjusted. The diagnosis of brucellosis was made by isolating the *Brucella* species from blood cultures and by standard tube agglutination testing (SAT) with a titer of 1/160 or more for *Brucella* antibodies in the presence of compatible clinical findings. The BACTEC (Becton Dickinson Diagnostic Instrument System, Sparks, Md) for initial blood cultures with subculturing onto chocolate blood agar at 37°C in CO₂ was used. At least 2 blood cultures were carried out for every patient before treatment. SAT (including both immunoglobulins G and M) was performed in tubes with double

dilution method from an initial dilution of 1:20 to 1:1280 using a commercial *B. abortus* antigen (Linear Chemicals, Barcelona, Spain). For each patient, positive and negative control tubes were used.

Five different treatment regimens were used: 68 patients (48.5%) received rifampin plus doxycycline; 51 (36.4%) streptomycin plus doxycycline; 14 (10.0%), rifampin plus ciprofloxacin; 4 (2.8%), rifampin plus doxycycline plus streptomycin; and 3 (2.1%), rifampin plus trimethoprim-sulfamethoxazole. Streptomycin was given for 3 weeks, and other antimicrobials were given for 6 weeks. Excluding streptomycin, all drugs were taken orally. Thirty-seven patients were hospitalized. The mean hospitalization time for the patients was 5.15 ± 2.14 days (range, 2–13 days). All patients were followed up at least 3 months after completing therapy. The mean follow-up period of the patients was 5.64 ± 2.55 months (range, 3–12 months). After the treatment period, patients called 15 days later for the first control visit and after then at the 1st, 3rd, 6th, and 12th months. At the first control visit, complete blood count, C-reactive protein (CRP) tests, and liver function tests were performed besides physical examination, BDI, STAI-I, and STAI-II. At the rest of the control visits, only SAT values were evaluated besides physical examination.

Relapse was defined as initial improvement with reappearance of symptoms and signs during the treatment period or within 2 months after discontinuation of treatment. Patients were classified based on the duration of the systemic disease before admission to the hospital: acute brucellosis

TABLE 1. Presenting Symptoms and Physical Examination Findings in 140 Patients With Brucellosis at the First Examination on Admittance

Characteristics	Acute, n = 75	Subacute, n = 30	Chronic, n = 35	Total, n = 140
Symptoms				
Malaise	69 (92.0)	29 (96.7)	35 (100)	133 (95.0)
Sweating	62 (82.7)	27 (90.0)	31 (88.6)	120 (85.7)
Arthralgia	62 (82.7)	25 (83.3)	32 (91.4)	119 (85.0)
Myalgia	54 (72.0)	26 (86.7)	32 (88.6)	112 (80.0)
Fever	59 (78.7)	25 (83.3)	24 (68.6)	108 (77.1)
Low back ache	49 (65.3)	28 (93.3)	30 (85.7)	107 (76.4)
Headache	53 (70.7)	24 (80.0)	27 (77.1)	104 (74.3)
Nausea	46 (61.3)	16 (53.3)	16 (45.7)	78 (55.7)
Anorexia	49 (65.3)	14 (46.7)	9 (25.7)	72 (51.4)
Constipation	34 (45.3)	20 (66.7)	16 (45.7)	70 (50.0)
Weight loss	42 (56.0)	13 (43.0)	8 (22.9)	63 (45.0)
Abdominal pain	30 (40.0)	13 (43.3)	20 (57.1)	63 (45.0)
Cough	22 (29.3)	6 (20.0)	13 (37.1)	41 (29.3)
Vomiting	22 (29.3)	7 (23.3)	5 (14.3)	34 (24.3)
Diarrhea	12 (16.0)	5 (16.7)	8 (22.9)	25 (17.9)
Signs				
Fever	47 (62.7)	18 (60.0)	9 (25.7)	74 (52.9)
Hepatomegaly	19 (25.3)	6 (20.0)	4 (11.4)	29 (20.7)
Splenomegaly	12 (16.0)	1 (3.3)	4 (11.4)	17 (12.1)
Lymphadenopathy	2 (2.6)	5 (16.6)	1 (2.9)	8 (5.7)

Values are presented as n (%).

TABLE 2. BDI and STAI Results in Patients With Brucellosis and in the Control Group

Mental Disorder	Control n (%) (± SD)	Brucellosis n (%) (± SD)	P
Depression, n (%)			
No (BDI, cut point = 17)	107 (92.2)	61 (62.2)	0.000*
Yes (BDI, cut point = 17)	9 (7.8)	37 (37.8)	
Total	116 (100.0)	98 (100.0)	
Anxiety			
STAI-I	38.81 ± 9.75	46.21 ± 12.87	0.000†
STAI-II	41.43 ± 7.21	46.98 ± 10.11	0.000†

* χ^2 Test.

†t Test.

(<2 months), subacute brucellosis (2–12 months), and chronic brucellosis (>12 months).

Data were analyzed using Statistical Package of Social Sciences (SPSS 11.5 for Windows; SPSS Inc, Chicago, Ill). χ^2 Test, t test, and Kruskal-Wallis test were used for statistical analysis.

RESULTS

Of the 140 patients with brucellosis, 102 (72.9%) were female, and 38 (27.1%) were male. Mean ages were 46.44 ± 14.58 years for male patients and 44.11 ± 18.22 years for female patients. Patients' ages ranged from 2 to 77 years (mean, 45.81 ± 15.62 years). Twenty-five patients (17.8%) had a history of contact with animals such as sheep and goat, and 31 (22.1%) had a history of consumption of raw milk and/or its products. Seventy-five patients (53.6%) were housewives; the remaining 65 (46.4%) comprised 34 officers, 12 tradesmen, 7 students, 5 farmers, 4 workers, and 3 preschool children. The highest seasonal distribution was observed in summer (July), and the lowest was in winter (January). All of the patients were questioned for the duration of the symptoms before admission to the hospital:

75 patients (53.5%) had a duration of less than 2 months (acute); 30 (21.4%), 2 to 12 months (subacute); and 35 (25.0%), longer than 12 months (chronic).

Malaise (133 patients, 95.0%), sweating (120, 85.7%), arthralgia (119, 85.0%), myalgia (112, 80.0%), and fever (108, 77.1%) were the main presenting symptoms. Fever (74 patients, 52.9%), hepatomegaly (29, 20.7%), and splenomegaly (17, 12.1%) were the most common physical examination findings (Table 1). Only 1 patient had ocular involvement, and orchitis was observed in 6 male patients.

Of 140 patients, 98 were examined by a psychiatrist, of whom 37 (37.8%) were observed to have depression. Beck depression points were min = 0, max = 52, average = 15.92, and SD = 11.42. STAI-I criterion points were min = 21, max = 76, average = 46.21, and SD = 12.87. STAI-II criterion points were min = 32, max = 68, average = 46.98, and SD = 10.11 (Table 2).

A whole-body scintigraphy with technetium Tc 99m-MDP was done in 114 patients who have focal joint and bone complaints and findings; 74 (64.9%) had osteoarticular involvement, and 40 (35.1%) were normal. Sacroiliitis was the most common manifestation (37 patients, 50.0%; 22 were unilateral); followed by spondylodiscitis (13, 17.5%); arthritis (8, 10.8%); osteomyelitis (2, 2.7%); spondylodiscitis and arthritis (9, 12.1%); sacroiliitis and spondylodiscitis (1, 1.3%); sacroiliitis, spondylodiscitis, and arthritis (2, 2.7%); arthritis, spondylodiscitis, and synovitis (1, 1.3%); and arthritis, sacroiliitis, spondylodiscitis, and periostitis (1, 1.3%). The results of the whole-body scintigraphy are shown in Table 3.

Most of the patients had mild elevated erythrocyte sedimentation rate, CRP levels, and normal leukocyte counts. A few had leukopenia and leukocytosis. Lymphocytosis was observed only in 7 patients (5.0%). Testing of biochemicals, such as aspartate aminotransferase, alanine aminotransferase, lactate dehydrogenase, blood urea nitrogen, and creatinine, was also studied, and most of the results were within reference ranges. All patients had SAT during admission to the hospital (Table 4). The initial SAT titers were 1/160 or more in 134 patients and 1/80 in 6. Patients who had initial SAT titers of 1/80 were retested, and results showed 1/320 in 5 patients and 1/160 in 1.

TABLE 3. Results of Whole-Body Scintigraphy in 74 Patients With Brucellosis

Results of Scintigraphy	Acute, n = 39	Subacute, n = 17	Chronic, n = 18	Total (%), n = 74
Sacroiliitis	23	5	9	37 (50.0)
Spondylodiscitis	4	8	1	13 (17.5)
Arthritis	4	0	4	8 (10.8)
Osteomyelitis	2	0	0	2 (2.7)
Spondylodiscitis and arthritis	4	3	2	9 (12.1)
Sacroiliitis and spondylodiscitis	0	0	1	1 (1.3)
Sacroiliitis, spondylodiscitis, and arthritis	0	1	1	2 (2.7)
Spondylodiscitis, arthritis, and synovitis	1	0	0	1 (1.3)
Arthritis, sacroiliitis, spondylodiscitis, and periostitis	1	0	0	1 (1.3)

At least 2 blood cultures were performed in all patients, and 22 patients were found positive for *B. melitensis*. All microorganisms isolated were *B. melitensis*. Of the 22 patients, initial SATs were 1/80 in 1 patient, 1/160 in 5, 1/320 in 4, 1/1640 in 4, and 1/1280 in 8.

Various treatment combinations were used depending on the status of patients such as if a patient is pregnant, a child, or an adult. During the treatment period, patient compliance was assessed by a questionnaire prepared by our consultant and revealed only mild side effects due to the treatment applied; no severe side effect was found to make us stop the treatment. Side effects such as epidermal rash (5 patients), headache (1 patient), nausea (3 patients), and mouth dryness (2 patients) were recorded.

Relapse was observed in 5 patients; 4 responded well to a second course of therapy, and 1 patient, who relapsed with orchitis, could be cured in the third course of the treatment. There were 5 different treatment regimens applied; according to the relapse rates observed in these groups, Kruskal-Wallis nonparametric calculations revealed no difference between treatment groups ($P < 0.5$; Kruskal-Wallis nonparametric test).

DISCUSSION

Brucella species can infect a wide variety of domestic and wild animals. Brucellosis is a true zoonosis because humans acquire the infection directly or indirectly from infected animals. About 500,000 cases of human brucellosis have been reported annually worldwide, but this almost certainly is a gross underestimation of the true incidence of this disease.¹ The clinical manifestation of brucellosis is very great, ranging from asymptomatic infection to serious debilitating disease. For the most part, brucellosis is a systemic infection that can involve any organ of the body. Symptoms are nonspecific and may include fever, chills, weight loss, sweats, headache, myalgia, fatigue, and depression.³

According to the results of several studies, brucellosis affected males and females equally^{9–11} or affected more males than females.^{12–15} But the results of our study show that more females (72.9%) were affected than males (27.1%). Our hospital is a reference hospital that widely accepts patients from nearby countrysides where women mostly carry out the livestock maintenance and processing of milk and its products. This is, most probably, the reason why most of our

TABLE 4. Laboratory Data of 140 Patients With Brucellosis

	Acute, n = 75	Subacute, n = 30	Chronic, n = 35	Total (%), N = 140
WBC ($\times 10^9/L$)				
<4	9	1	1	11 (7.8)
4–10	58	28	34	120 (85.7)
>10	8	1	0	9 (6.4)
Lymphocytosis ($\geq 45\%$)	5	1	1	7 (5.0)
Platelet ($\times 10^9/L$)				
<150	6	1	0	7 (5.0)
150–450	67	29	34	130 (92.8)
>450	2	0	1	3 (2.1)
Hemoglobin (g/dL)				
Female (≤ 10)	5	8	4	17 (12.1)
Male (≤ 12)	9	4	4	17 (12.1)
ESR (mm/h)				
<20	34	13	16	63 (45.0)
20–1100	38	13	19	70 (50.0)
>100	1	0	0	1 (0.7)
CRP (>6 mg/dL)	54	20	24	98 (70.0)
AST (>40 IU/L)	13	1	0	14 (10.0)
ALT (>40 IU/L)	19	1	1	21 (15.0)
LDH (>233 IU/L)	1	0	0	1 (0.7)
BUN (>25 mg/dL)	3	1	0	4 (2.8)
Creatinine (>1.4 mg/dL)	0	1	0	1 (4.2)
1/160	6	2	3	11 (7.8)
1/320	25	15	13	53 (37.8)
1/640	30	3	5	38 (27.1)
1/1280	26	4	1	31 (22.1)
Blood cultures	20	2	0	22 (15.7)

ALT indicates alanine aminotransferase; AST, aspartate aminotransferase; BUN, blood urea nitrogen; ESR, erythrocyte sedimentation rate; LDH, lactate dehydrogenase; WBC, white blood cell.

patients were women. Although brucellosis is most common in adolescents and adults, it can occur at any age.^{10,11,16} In our study, 76 patients (52.4%) were between 21 and 50 years old, whereas only 9 patients were between 0 and 20 years old. The spread of infection is usually through the ingestion of unpasteurized milk and its products such as fresh soft cheese. In endemic areas, the majority of cases occur in dairymen, herdsman, abattoir workers, butchers, and veterinary surgeons.¹ We found that 25 (17.8%) of 140 patients had a history of contact with animals such as sheep and goat, and 31 (22.1%) had a history of consumption of raw milk and/or its products. Forty-six and a half percent of our patients had chronic and subacute brucellosis. As raw milk and its products are widely used in our region, the patients may not specifically recognize the probable source of their infection.

Considering the duration of the disease, 75 patients (53.5%) in our study presented with acute, 30 (21.4%) subacute, and 35 (25.0%) chronic brucellosis, whereas other studies presented the following results: 75.0% acute, 19.0% subacute, 6.0% chronic brucellosis from Memish et al;¹⁶ 25.0% acute, 59.0% subacute, 16.0% chronic brucellosis from Gür et al;¹¹ and 56.0% acute, 25.0% subacute, 19.0% chronic brucellosis from Khateeb et al.¹⁵

In our study, the presenting symptom-percentages, including fever, sweats, arthralgia, lower back pain, headache, nausea, vomiting, myalgia, lack of appetite, and cough, were found to be different from those previously reported.^{11,16,17}

Fever in patients with brucellosis often shows diurnal variation and may come and go for over a few weeks or months if the patients are untreated. This "undulant" fever pattern was not invariably seen.¹ Considering the patients' history, we learned that 108 patients (77.1%) had fever, but in physical examination, we observed fever ($\geq 37.5^{\circ}\text{C}$) in only 74 patients (52.8%). This result can be attributed to the use of analgesics and antibiotics before admission to the hospital or to some presenting their cases to be subacute or chronic.

Because liver is the largest organ of the reticuloendothelial system, it is probably always involved in brucellosis. However, liver function tests are usually only slightly elevated. Hepatic lesions are resolved with antimicrobial therapy.² Hepatomegaly was observed in 29 patients (20.7%); this finding was higher than in previous studies where ranges are from 6.0% to 9.7%^{14–16} and lower than those where ranges are from 23.1% to 66.1%.^{10–12,18,19} Like liver, spleen can also be involved in brucellosis; in different studies,^{10–12,14–16,18–20} the rates of splenomegaly were found to be from 7.0% to 56.6%. In our study, splenomegaly was observed in 17 patients (12.1%). Lymphadenopathy was reported in some studies.^{10–12,14,20} We observed lymphadenopathy in 8 patients (5.7%); 5 had cervical involvement, and 3 had inguinal involvement.

A variety of ocular involvements had been defined in patients with brucellosis.^{2,21} One of our patients was observed with iridocyclitis and responded well to rifampin plus doxycycline therapy.

Orchitis occurs in up to 20% of males with brucellosis and is an important focal form of human brucellosis which may cause serious complications. The genitourinary complications

of brucellosis usually respond favorably to treatment, but testicular atrophy and abscesses requiring steroid treatment have been described.¹¹ Orchitis was observed in 6 (15.8%) of 38 male patients; 1 patient was clinically determined with 2 relapsing episodes and could be treated with combination therapy of rifampin plus streptomycin plus doxycycline.

The most common finding of psychiatric disturbance in patients with brucellosis is depression.¹¹ In this study, BID and STAI were applied to 98 patients with brucellosis; depression was observed in 37 patients (37.8%). STAI-I and STAI-II demonstrate the levels of anxiety: a low score means a low anxiety level, and a high score means a high anxiety level. There is no cutoff point previously determined for the Turkish society. Either the depression rates or points of STAI-I and STAI-II in patients with brucellosis were statistically higher than in the control group. To our best knowledge, this study was the first to investigate the relationship between brucellosis and depression and between brucellosis and anxiety; thus, we could not compare our study with any other. In the current study, the scores obtained from BDI, STAI-I, and STAI II revealed at the follow-up period that depression and anxiety improved by antibiotic therapy, without any antidepressive or antipsychotic therapy.

Osteoarticular involvement has been found to be one of the most frequent complications of brucellosis, and its prevalence can vary from 19.0% to 69.0%.^{9–11,14–19,22} The criteria of diagnosis and the age of the patients can change the incidence of osteoarticular involvement. For the diagnosis of osteoarticular involvement, plain radiographs, bone scintigraphy, and magnetic resonance imaging can be used. Plain radiographs of the spine can be obtained rapidly and are inexpensive and accessible, but their sensitivity is low at initial periods of the disease. Radionuclide scintigraphy is very sensitive but is poorly specific for detecting inflammatory alterations in bones. Although it is well suited for total body assessment of the extent and distribution of musculoskeletal involvement, the limited tissue resolution of scintigraphy may necessitate the use of additional imaging modalities such as magnetic resonance imaging.^{13,23} In 114 patients, we used the whole-body scintigraphy and found that 74 patients (64.9%) had osteoarticular involvement. Sacroiliitis was the most common manifestation (37 patients, 50.0%; 22 were unilateral); followed by spondylodiscitis (13, 17.5%); arthritis (8, 10.8%); osteomyelitis (2, 2.7%); spondylodiscitis and arthritis (9, 12.1%); sacroiliitis and spondylodiscitis (1, 1.3%); sacroiliitis, spondylodiscitis, and arthritis (2, 2.7%); arthritis, spondylodiscitis, and synovitis (1, 1.3%); and arthritis, sacroiliitis, spondylodiscitis, and periostitis (1, 1.3%).

As reported elsewhere,² other than blood cultures and SAT, hematologic testing, such as white blood cell count, erythrocyte sedimentation rate, and biochemical testing, such as aspartate aminotransferase, alanine aminotransferase, lactate dehydrogenase, CRP, blood urea nitrogen, and creatinine, have been of little value. Similarly, we found moderate elevations or normal results in hematologic and biochemical findings in our study. A presumptive diagnosis of brucellosis can be made by demonstrating high or raising

4-fold titers or more of specific antibodies in patients' sera, and definitive diagnosis can be made by isolating the microorganisms from blood, bone marrow, or other tissues. The yield of blood cultures in brucellosis ranges from 13.7% to 80.3%.^{9–16,18,20} In our study, we found that 22 (15.7%) of 140 patients had positive blood cultures for related microorganisms; all microorganisms were *B. melitensis*.

As *Brucella* species are facultative intracellular parasites, complete eradication of the microorganisms from the body is difficult to achieve, and relapses are common when a single drug or an inadequate treatment duration was given.⁹ For these reasons, we did not treat any patient with a single agent, and adequate duration of therapy was given to all patients. The relapse rate of our cases is low (3.6%) and is similar to some studies^{9,10} but is lower than those ranging from 8.7% to 33.5% as reported elsewhere.^{14,16,17}

In conclusion, brucellosis will continue to be a public health problem in countries where consumption of raw milk and/or its products and stockbreeding are widespread. Prevention of human brucellosis depends on the elimination of the disease from domestic livestock by vaccinations of the susceptible animals, skin test for sheep, serologic test on milk, blood samples for cattle, and pasteurization of milk. Moreover, educating the people working with these susceptible animals is important in the prevention of brucellosis.

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