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Demographic characteristics, laboratory features and complications in 346 cases of brucellosis: A retrospective study from Qatar

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ARTICLE INFO

Keywords:

Brucellosis
Brucella
focal brucellosis
melitensis

ABSTRACT

Objectives: To study the epidemiology and laboratory findings and outcomes of human brucellosis in the state of Qatar.

Methods: A retrospective study involving adult patients with a definitive diagnosis of brucellosis was conducted.

Results: Of the 346 patients 299 were males. The mean age was 39.62 years. 120 patients had history of drinking raw milk and 116 had a history of contact with animals. Fever (89.9%) and myalgia (56.6%) were the most common presenting symptoms observed. Raised C-reactive protein level was the most frequent laboratory finding noted. Alanine aminotransferase and aspartate aminotransferase levels were raised to three times the normal in 39.6% and 37% of patients, respectively. Blood culture was positive in 72.8% whereas *Brucella* immunoglobulin G antibody and immunoglobulin M antibody titer was positive in 72.5% and 73.1% patients, respectively. Approximately 21.4% had focal involvement and osteoarticular (11.6%) involvement was the most frequently observed focal form. Doxycycline with rifampicin or gentamicin was the common regimen received. Relapse was seen in 7.2% patients.

Conclusion: Human brucellosis continues to be a serious health issue in Qatar predominantly affecting healthy young adult men resulting in significant morbidity. Preventive measures and community awareness particularly among high-risk groups will help in decreasing the prevalence of the disease and its aftereffects.

Introduction

Human brucellosis, also known as Malta fever or Mediterranean fever, is a serious but often overlooked zoonotic disease caused by bacteria belonging to the *Brucella* species. It has a widespread global distribution, with approximately 500,000 new cases reported each year across more than 170 countries [1]. However, due to underdiagnoses or underreporting, the actual/true rates of human brucellosis are much higher than what is reported [2].

Brucella bacteria is a small gram-negative facultative intracellular aerobic coccobacillus that infects both domestic animals and humans. Goats, sheep, camels, cattle, and buffalo are examples of domestic livestock affected by the *Brucella* microorganisms. Domestic animal and livestock brucellosis has a significant negative impact on socio-economic life, particularly in Middle Eastern countries where the disease is endemic [3]. The organism can infect a wide range of animals and live-

stock. Humans are incidental hosts, infected through the consumption of unpasteurized milk or dairy products, as well as direct contact with animals or animal products [2]. Farm workers, abattoir staffs, and veterinarians are at a higher risk of contracting the disease [4].

Brucellosis is endemic in the Middle East, Central Asia, Latin America, Africa, and the Mediterranean region [5]. The Middle Eastern nations account for a sizable proportion of human brucellosis cases. Yemen has the highest incidence rate in the Middle Eastern countries (88.6/100,000 population), followed by Syria (40.6). The annual incidence rate in Palestine (19.1/100,000), Iran (18.6), and the Kingdom of Saudi Arabia (12.3) is also high [6].

The clinical features of brucellosis include fever, arthralgia, and myalgia. Due to the myriad of its presentation and nonspecific nature of manifestation, it can mimic other diseases, resulting in delayed diagnosis/missed diagnosis and delayed initiation of specific treatment. This could lead to complications [7]. Even though most cases of brucellosis can be cured completely with appropriate treatment without any sequelae, there is a risk of complications developing due to incomplete or partial treatment, drug resistance, drug side effects/toxicity, or relapse, which can lead to significant morbidity.

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<https://doi.org/10.1016/j.ijregi.2023.11.007>

Received 10 October 2023; Received in revised form 8 November 2023; Accepted 12 November 2023

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Despite the fact that brucellosis is common in Middle Eastern countries, relatively few studies from Qatar have been published. As a result, we chose to investigate the epidemiological, clinical, and laboratory aspects and outcomes of brucellosis patients in Qatar.

Methods

Study design and setting

A retrospective observational study was conducted at Hamad Medical Corporation, Doha, Qatar from April 2021 to March 2022.

Study population

Inclusion criteria

Adults over the age of 18 who were diagnosed with brucellosis between January 2015 and December 2020 were included in the study. The diagnosis of brucellosis was done based on one of the following criteria: A confirmed case was defined as a clinically compatible illness with the identification of *Brucella species* in the culture of a clinical specimen. A presumptive case was defined as a clinically compatible disease with a *Brucella* antibody titer of greater than or equal to 1:160 by standard tube agglutination test.

Relapse is defined as the recurrence of characteristic signs and symptoms (with positive culture or serology of brucellosis) occurring at some time after the completion of a course of treatment [8].

Exclusion criteria

Patients who were diagnosed with brucellosis based on clinical suspicion but had a negative blood culture and antibody titer, as well as those with missing data, were excluded.

Data collection

All files with the diagnosis of brucellosis were identified from the medical records department using the health care numbers. These files were retrospectively analyzed for study inclusion criteria. Patients full filling the study inclusion criteria were included for the final analysis. Using the patients' healthcare numbers, data were retrieved from the clinical information system. Demography, co-morbid conditions, clinical features, laboratory parameters, radiological investigations, complications, and treatment were all documented.

Statistical analysis

This study was conducted mainly as descriptive study and hence descriptive statistics were used to describe, summarize, and determine the sample characteristics and distribution of various considered parameters related to demographics, epidemiological, clinical, laboratory features and treatment-outcomes in patients with brucellosis. The normally distributed data and results were presented with mean and standard deviation (SD), whereas median and interquartile range was used in non-normal (skewed) data distribution. Categorical data were summarized using frequencies and respective percentages. In addition, laboratory data which primarily were measured on quantitative scale were categorized (using standard classification) and then summarized using frequencies and percentages across each subcategory. All Statistical analyses were performed using statistical packages SPSS version 27.0 (Armonk, NY: IBM Corp).

Results

Basic demography and clinical profile

A total of 355 files were reviewed and 9 files were excluded (missing data; five, negative blood culture or titer; four) leaving a cohort of 346

Table 1
Demographic features and basic clinical characteristics.

Variable	Number (%) Total no-346
Age (years)	
Mean \pm SD	39.62 \pm 15.05
18-35	173 (50)
36-50	97 (28)
51-65	52 (15)
>65	24 (6.9)
Gender	
Male	299 (86.4)
Female	47 (13.6)
Length of stay (days)	
Mean \pm SD	8.38 \pm 8.41
0 - 7	200 (57.8)
8 -14	108 (31.2)
15 - 30	29 (8.4)
>30	9 (2.6)
Occupational exposure to animals	
No	218 (63)
Yes	128 (37)
Exposure/Source	
Unknown	107 (30.9)
Contact with animal	116 (33.5)
Contact with patient	3 (0.9)
Drinking raw milk	120 (34.7)
Symptoms	
Fever	311 (89.9)
Myalgia	196 (56.6)
Joint pain	93(26.9)
Head ache	83 (24)
Back pain	78 (22.5)
Abdominal Pain	18 (5.2)
Cough	24 (6.9)
Scrotal pain	26 (7.5)
Nausea/Vomiting	29 (8.4)
Weight loss	13 (3.8)
Others	5 (1.4)
Duration of symptoms (days)-	
Mean \pm SD	20.92 \pm 23.76
0-15	216 (62.4)
16-30	86 (24.9)
31-60	28 (8.1)
>60	16 (4.6)
Physical findings	
Hepatomegaly	14 (4)
Splenomegaly	22 (6.4)
Lymphadenopathy	14 (4)
Jaundice	9 (2.6)
Scrotal swelling	3 (0.9)
Others	5 (1.4)
Body mass index	
Mean \pm SD	24.39 \pm 5.05
<18.5	27 (7.8)
18.5-24.9	151 (43.6)
25- 29.9	65 (18.8)
\geq 30	44 (12.7)

for the final analysis. The majority (299/ 86.4%) were males, with a mean age of 39.62 \pm 15.05 years. A further breakdown of age groups revealed that the majority of the study population (50% of the total) was made up of adults aged 18 to 35.

A total of 34.7% (120) had a history of drinking raw milk and 33.5% (116) had a history of contact with animals. A total of 37% (128) of the study population had a history of occupational exposure to animals or animal products. The mean body mass index was 24.39 \pm 5.05 with 43.6% (151) having a body mass index between 18.5 and 24.9. The mean duration of symptoms was 20.92 \pm 23.76 days, with the majority (62.4%) experiencing symptoms for less than 15 days. Fever (311/89.9%) and myalgia (196/56.6%) were the most common symptoms observed in the study population. Table 1 provides demographic and clinical profile information.

Table 2
Nationality of the study subjects.

Nationality	Number of subjects	Percentage
Bangladeshi	115	33.2
Qatari	71	20.5
Sudanese	47	13.6
Indian	21	6.1
Nepalese	16	4.6
Pakistani	16	4.6
Syrian	8	2.3
Ethiopian	7	2.0
Egyptian	6	1.7
Yemeni	6	1.7
Eritrean	5	1.4
Iranian	3	0.9
Mauritanian	3	0.9
Cuban	2	0.6
Jordanian	2	0.6
Omani	2	0.6
Palestinian	2	0.6
Saudi	2	0.6
Sri Lankan	2	0.6
Armenian	1	0.3
Canadian	1	0.3
Djiboutian	1	0.3
Filipino	1	0.3
Ghanaian	1	0.3
Iraqi	1	0.3
Kuwaiti	1	0.3
Somali	1	0.3
Turkmenistan	1	0.3
Algerian	1	0.3

A total of 73 (21.1%) patients had co-morbidities, with the majority (10.7%) having a single co-morbid condition. Diabetes mellitus (16.2%) was the most common co-morbid condition observed followed by hypertension (13%). On analysis of the nationality of the study group, 33.2% of the study subjects were from Bangladesh, followed by Qatari nationals 20.5% (Table 2).

Laboratory parameters

Anemia (31.5%) and leukopenia (18.5%) were the most common abnormality found in complete blood count. The mean hemoglobin and white cell counts were 12.64 ± 1.98 and 6.76 ± 3.52 , respectively. Thrombocytopenia and thrombocytosis were noted in 17.6% and 8.1% of patients, respectively.

The rise in hepatic transaminase showed a similar trend. Alanine aminotransferase (ALT) levels increased in 51.7% (179) of patients, while aspartate aminotransferase (AST) levels increased in 51.5% (178) of patients. Most patients had levels that were less than three times the normal value (39.6% for ALT and 37% for AST). A rise of more than three times the normal value was observed in 12.1% (42) of patients for ALT and 14.5% (50) for AST. Most patients (82.1%) had an elevated C-reactive protein (CRP) value and the majority (63.9%) had a value between 5 and 100. The mean CRP value was 67.85 ± 69.77 . *Brucella* antibody immunoglobulin G and immunoglobulin M titer were positive in 72.5% and 73.1% of patients, respectively. A total of 76.3% had positive *Brucella abortus* and *Brucella melitensis* titer. Blood culture (BACTEC) was positive in 72.8% and *B. melitensis* was isolated in 21.7% of patients and in the majority (52.3%) of patients no specific species could be identified (Table 3).

Focal brucellosis / complications

Approximately 21.4% (74) of the patients had features of focal brucellosis with osteoarticular involvement (Spine [29/8.4%] and peripheral joint [11/3.2%]) being the most frequent type observed. Further 23 (6.6%) patients had clinical features of epididymo-orchitis of which 13

patients had confirmation by ultrasonography. Six patients were diagnosed with neurobrucellosis based on cerebrospinal fluid analysis showing features of meningitis. Two patients had infective endocarditis also (Table 4).

Treatment received

Doxycycline with rifampicin 116 (33.5%) or gentamicin 102 (29.5%) was the common regimen received by the patients. Most patients received antibiotics for 6 weeks (61%). The drug-induced side effect was observed in 32 (9.2%) of the patients and most common being hepatitis, 23 (6.6%). In 23 (6.6%) patients the antibiotic was changed. Relapse was seen in 25 (7.2%) patients (Table 5).

Discussion

We sought to study the profile of patients diagnosed with *Brucella* infection in the state of Qatar. According to our findings, infection was more common in young adult men between the ages of 18 and 35. This could be because Qatar's workforce is primarily composed of young expatriate men. Second, in almost all cases, men are involved in the raising/breeding, feeding, and milking of animals in the state of Qatar. Furthermore, men make up the majority of those employed in abattoirs and butchery jobs that have direct contact with animals and animal products. These men frequently consume raw milk. In Qatar, the most common livestock/animals are camels, sheep, and goats.

Our findings are consistent with those of a previous study from Qatar. Rahil et al. [9] who studied 72 cases of human brucellosis between 2000 and 2006, reported a male preponderance of 77.8% and an age range of 20-60 years (77.8%). The prevalence of disease in different age groups could not be compared to our results because they did not conduct a subgroup analysis of various age groups. Other studies from the Middle East region found similar results to the current study. A study conducted by Al Shehhi et al. [10] in Abu Dhabi on the incidence of brucellosis for 6 years from 2010 to 2015 reported that the infection was more common in young (20-39 years-48.3%) expatriate (61%) men (79%).

A recent study on the epidemiology of brucellosis in the West Bank of Palestine from 2000 to 2020 by Amro et al. [11] found a male preponderance with an M: F ratio of 1.3:1, a mean age of 25 ± 16.9 years, and 29.3% of the subjects aged 11 to 20 years. Children under the age of 10 made up 17.3% of the subjects in their study. Because our study only included adults over the age of 18, the frequency of the disease in children could not be compared to other studies. Similar findings have been reported in studies conducted in Iran, where brucellosis is endemic. Norouzzinezhad et al. [12] studied brucellosis trends in Iran from 2009 to 2017 and discovered that 57.9% of patients were males and that infection was higher in younger age groups of 25-44 years (36.2%) followed by 16-24 years (16.7%).

Buzgan et al. [13] from Turkey, another brucellosis-endemic country, reported that 53.4% of their patients were aged 15 to 35. In contrast to our findings, their study discovered a higher rate of infection (52.4%) in females.

In contrast to our findings, few studies have found a higher prevalence of infection in females and older age groups; Savas et al. [14] female (72.9%) and mean age (45.8 years), Demiroglu et al. [15] female (58.9%) and mean age (45.4 years). Gender differences in some studies may be due to the differences in social and cultural practices in daily life and farming. In some countries women folk assist or work alongside men in farms and ranches.

Study from Balkan Peninsula reported results similar to our study in terms of gender, but differ in terms of age. A study from the Republic of Macedonia where brucellosis is endemic, found that the mean age was 36 years. They divided the study participants into two groups: those who had occupational exposure and those who did not. A total of 74.9% in the occupational exposure and 59.9% in the non-exposure group were men [16].

Table 3
Laboratory parameters.

Variables	Number (%)	Median (interquartile range)
Hemoglobin – g/dl		
Mean ± SD	12.64 ±1.98	12.9 (11.6-14.1)
No Anemia (≥12 g/dl in females/≥14 in males)	231 (66.8)	
Anemia present (<12 g/dl in females/ <14 in males)	109 (31.5)	
White blood count-		
Mean ± SD	6.76 ±3.52	6.09 (4.4-8.0)
Normal- $4-10 \times 10^3 / \mu\text{l}$	228 (65.9)	
Leucopenia- $<4 \times 10^3 / \mu\text{l}$	64 (18.5)	
Leukocytosis- $>10 \times 10^3 / \mu\text{l}$	48 (13.9)	
Platelet count		
Mean ± SD	241.66 ±113.18	225 (167-295)
Normal- $150-400 \times 10^3 / \mu\text{l}$	232 (67.1)	
Thrombocytopenia $<150 \times 10^3 / \mu\text{l}$	61 (17.6)	
$>400 \times 10^3 / \mu\text{l}$	28 (8.1)	
Alanine aminotransferase - U/l		
Mean ± SD	72.52± 83.56	45 (28-78)
0-41	148 (42.8)	
42-120	137 (39.6)	
>120	42 (12.1)	
Aspartate aminotransferase - U/l		
Mean ± SD	74.02 ±88.23	44 (29-84.5)
0-40	143 (41.3)	
41-120	128 (37)	
>120	50 (14.5)	
Bilirubin direct - $\mu\text{mol/l}$		
Mean ± SD	25.84 ±32.73	18.7 (11-29)
Normal (<6)	3 (0.9)	
Abnormal (>6)	44(12.7)	
Total bilirubin - $\mu\text{mol/l}$		
Mean ± SD	13.27 ±18.32	9.8 (6.1-14)
Normal (0-21)	290 (83.7)	
Abnormal (>21)	38 (11)	
Pro calcitonin- ng/ml		
Mean ± SD	0.85 ±3.09	0.24 (0.09-0.50)
<0.5	120 (34.7)	
0.5-2	31 (9)	
>2	10 (2.9)	
C-reactive protein - mg/l		
Mean ± SD	67.85±69.77	47.5 (19.9-88.3)
Normal (0-5)	20 (5.8)	
5-100	221 (63.9)	
>100	63 (18.2)	
Brucella antibody immunoglobulin G^a		
Negative	45(13)	
Positive	251 (72.5)	
Equivocal	8 (2.3)	
Brucella antibody immunoglobulin M^a		
Negative	40(11.6)	
Positive	253 (73.1)	
Equivocal	13 (3.8)	
Brucella abortus titer^a		
Negative	25 (7.2)	
Positive	264 (76.3)	
Brucella melitensis titer^a		
Negative	21 (6.1)	
Positive	264 (76.3)	
Blood culture		
Negative	94 (27.2)	
Positive	252 (72.8)	
Brucella species in blood culture-		
B. Canis	4 (1.2)	
B. Meletensis	75 (21.7)	
No specific species identified	181 (52.3)	

^a Brucella antibody titer of 1: 160 or more was considered positive.

In developed nations, the infection occurs mainly due to occupational exposure to animals or animal products whereas, in nations where brucellosis is endemic the primary mode of transmission is due to consumption of unpasteurized dairy products [7,17]. Approximately one-third of subjects in the present study had a history of consumption of raw milk (34.7%) and contact with animals (33.5%). Only three individuals had a history of contact with a patient with a *Brucella* infection.

Previous reports from Qatar found raw milk ingestion in 41.7% and a history of animal contact in 12.5% of patients [9]. The consumption rate in the present study is lower than that reported from neighboring Kuwait (69%) [18] but similar to the rates reported from Palestine (37.2%) [11] and the Balkan Peninsula (34.7%) [16]. However, the history of white cheese consumption was very high (80.9%) in the Palestinian study [11].

Table 4
Showing organ involvement.

Focal brucellosis	Number (%)
No focal involvement	272 (78.6)
Focal involvement	74 (21.4)
Peripheral joints	11 (3.2)
Spine and sacroiliac joints	29 (8.4)
Epididymo-orchitis	23 (6.6)
Neurobrucellosis	6 (1.7)
Cardiac	2 (0.6)
Pulmonary	3 (0.9)

Table 5
Treatment and its complication.

Treatment- Antibiotic regimen-	Number (%)
1. Doxycycline + gentamicin	102 (29.5)
2. Doxycycline + Rifampicin	116 (33.5)
3. Doxycycline + Rifampicin + Gentamicin	74 (21.4)
4. Doxycycline + Rifampicin + Streptomycin	11 (3.2)
5. Doxycycline + Streptomycin	20 (5.8)
6. Others	23 (6.6)
Duration of treatment	
6 weeks	211 (61)
12 weeks	117 (33.8)
Treatment completed	
No	13 (3.8)
Yes	333 (96.2)
Drug side effect	
No	314 (90.8)
Yes	32 (9.2)
Drug-induced hepatitis	
No	323 (93.4)
Yes	23 (6.6)
Ototoxicity	
No	345 (99.7)
Yes	1 (0.3)
Drug-induced acute kidney injury	
No	342 (98.8)
Yes	4 (1.2)
Change of drug	
No	323 (93.4)
Yes	23 (6.6)
Relapse	
No	321 (92.8)
Yes	25 (7.2)

Globally, the percentage of consumption of unpasteurized dairy products has a wide range among different nations or within a nation, ranging from between 22-30% in Iran [12,19] to between 62.6-94.6% in Turkey [13,15,20]. The wide variation in the percentage of consumption of raw dairy products and subsequent development of brucellosis in various studies could be due to multiple factors. Lack of awareness and knowledge regarding the ill effects of consumption of unpasteurized products, the prevalence of the disease in the animals/livestock in various countries, difference in the rate of animal vaccination and preventive measures used in decreasing animal brucellosis, and differences in the socio-economic status all might have a role to play.

Butchery, farming, livestock raising, and veterinarians are all high-risk occupations for brucellosis. In rare cases, transmission from the laboratory has also been reported [7,13]. Approximately 37% of the subjects in our study had a history of occupational exposure. Occupational exposure rates in published studies range from 44.8% by Buzgan et al. [13] to 62.7% by Amro et al. [11] and 60% by Mile et al. [16].

Clinically, brucellosis can manifest as acute, subacute, or chronic disease. The primary symptoms of acute brucellosis are fever, sweating, fatigability, weight loss, and back pain, whereas chronic brucellosis can present with myalgia, arthralgia, nervousness, depression, malaise, and emotional lability [7,17]. The most common symptoms observed in the present study were subjective fever (89.9%) and generalized myal-

gia (56.6%), followed by joint pain (26.9%). Rahil et al. [9] reported similar results in Qatar, with fever (93.1%) and arthralgia (33.3%). Furthermore, 62.5% of their study participants reported chills and 58.3% reported sweating. Fever, arthralgia, and myalgia were the most frequent symptoms reported in the past studies [11,13,16].

In contrast to a previous study in Qatar [9], where CRP level was elevated in only 34.7% of patients, our findings showed elevated CRP levels in 82.1% of patients, making it the most common abnormality found in blood tests. Mile et al. [16] found elevated CRP levels in 78.9% of patients, similar to our findings, while Buzgan et al. [13] found elevated CRP levels in 58.4% of patients. Anemia was found in 31.5% of patients, leucopenia in 18.5%, and thrombocytopenia in 17.6%.

The pattern of the rise of hepatic transaminases (ALT and AST) level was quite similar. Up to three times the normal value rise was observed in 39.6% and 37% for ALT and AST, respectively, and more than three times the normal was observed in 12.1% and 14.5%, respectively. However, bilirubin was raised only in 11% of patients. A study by Buzgan et al. [13] who divided patients into three groups based on duration of symptoms reported that transaminase elevation in 31.3%, 16.2%, and 12.9% in acute, subacute, and chronic brucellosis, respectively.

Brucellosis has a predilection for the reticuloendothelial system (RES). Since the liver is the largest RES organ it is invariably affected. Hepatic involvement can manifest as mildly tender hepatomegaly or as hepatitis with a moderate rise in aminotransferases or in rare cases hepatic abscess has been reported [21]. Jaundice is rare in brucellosis. Hepatomegaly is observed in 20-40% of patients whereas; hepatitis is seen in 5-40% of patients. Histologically the findings of *Brucella* infection include the presence of granuloma, kupffer's cell hyperplasia, and inflammatory infiltrations with or without necrosis [22].

72.8% of patients had positive blood cultures. Studies have reported a wide range of positivity in blood cultures ranging from 11.4% to 68.8% [9,13,15] The variation in rate of positive blood culture could be due to use of antibiotics prior to the culture which might affect the isolation of *Brucella* microorganism.

Human brucellosis can affect any organ in the body, and multiple organs can be affected in a single patient. The rate of focal involvement ranges from 6-92%, with the average being around 30% [19,23,24]. The most common is osteoarticular involvement, which occurs in up to 70% of cases [25–27]. The most commonly involved sites are the sacroiliac and spinal joints, which are involved in up to 84% and 54% of those with osteoarticular disease, respectively [28].

In our study, 74 (21.4%) patients had focal involvement, with 40 (11.6%) having osteoarticular involvement. Spondylitis and sacroillitis were the most common, affecting 29 (8.4%) of the patients, while 11 (3.2%) had peripheral joint involvement. Previous research has found a wide range of osteoarticular involvement ranging from 9.3-85% [7,13,29,30]. This wide variation in the rate of osteoarticular involvement could be attributed to several factors, including differences in the demographic characteristics of the population studied, and subjective variation in the diagnostic criteria used for diagnosing bone involvement as most were diagnosed clinically. Furthermore, because most studies were retrospective, there could have been a lack of or missing data, which could have contributed to the wide range.

The most common manifestation of genitourinary involvement in men is orchitis with or without epididymitis. Prostatitis and testicular abscess are rare complications. Epididymo-orchitis was found in 23 patients, with ultrasonography confirming 13 of them. Our findings support previous research on genitourinary involvement in brucellosis [13,29]. Six patients were diagnosed with neurobrucellosis.

The current study's findings indicate that brucellosis causes significant morbidity. Because the disease is more common in young men, particularly those who work in farms and abattoirs, any preventive measures should target this population. Health education and awareness about the importance of using gloves and face masks when in contact with animals, as well as cleaning animal shelters, will be beneficial in controlling the spread of the disease from animal to human. Consump-

tion of unpasteurized dairy products should be discouraged, and its ill effects and health hazards must be explained to the public. Seeking early medical attention in case of any suspected symptoms of brucellosis will aid in the early diagnosis and prevention of complications and reduce morbidity. Screening livestock for brucellosis and early isolation of infected animals may help to reduce the spread of the disease among animals and from animals to humans.

Conclusion

Brucellosis is common in young, healthy adult men who consume raw milk or has contact with animals. It has a high morbidity rate. Osteoarticular involvement is the most prevalent kind of focal brucellosis and neurobrucellosis was not uncommon. To limit illness spread and incidence, health education and community awareness on risk and mode of transmission, as well as preventive measures, particularly animal vaccination, are required.

Declarations of competing interest

The authors have no competing interests to declare.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Ethical approval

The study was approved by the ethical committee of the Medical Research Center at Hamad Medical Corporation, Doha, Qatar (Approval number: MRC-01-21-216). The consent was waived due to the retrospective nature of the review. The confidentiality of the included subjects was maintained by not disclosing the identification details and using anonymized data. The study was conducted in full compliance with the principles of “Declaration of Helsinki” Good Clinical Practice (GCP).

Acknowledgment

None.

Author contributions

IV: study design, data collection, analysis, manuscript writing, editing. VAN: study design, data collection, analysis, manuscript writing, editing. NP: study design, data collection, analysis, manuscript writing, editing. MZ: data collection, analysis, manuscript writing. JS: data collection, analysis, manuscript writing. NA: data collection, manuscript writing, editing. AMM: data collection, manuscript writing. JT: data collection, manuscript writing, editing. PSK: data collection, manuscript writing. PJ: data collection, manuscript writing. ABK: data analysis, manuscript writing, editing. AE: data analysis, manuscript writing, editing.

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