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Review on One Humped Camel Brucellosis

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Abstract: Camel brucellosis is an infectious disease known for its impact on reproductive performance of Camels. It has been diagnosed in all camel-rearing countries except Australia. In East African countries the seroprevalence of brucellosis can reach 40% (Herd level) and depends on the management system. The highest incidence is found when camels are kept together with infected small ruminants. The disease has great zoonotic importance. It is primarily caused by *Brucella abortus*, causing abortion in late stage of pregnancy and sterility in male. The methods by which the disease is transmitted from infected animals to susceptible animals are via ingestion of contaminated pastures, through skin, conjunctiva or the respiratory mucosa sexual activity. Direct bacteriological and molecular methods and indirect serological tests are used for brucellosis diagnostics. Generally it is a neglected disease with no official policy on its eradication in most developing countries. In Ethiopia, brucellosis in animals and humans has been reported from different localities of the country. Therefore, appropriate control and preventions methods are important in disease endemic and developing countries.

Key words: Arid Lands · Brucellosis · Dromedary Camels · Zoonosis

INTRODUCTION

Camels are even toed ungulates belonging to the genus *camelus* which distinguishes two species: the two-humped Bactrian camel (*Camelus bactrianus*) and the one-humped Arabian camel (*Camelus dromedarius*). In many developing countries of Asia and Africa, camels are the most important source of income for the nomadic population [1].

It is difficult to exactly determine the number of camels in the world, firstly, because it is mainly an animal of nomadic people and pastoralists who are moving frequently and secondly, because camels are not usually subjected to obligatory vaccination. So, an exhaustive census for the camels is quite difficult. Officially, the total number of camels in the world was around 27 million heads [2]. Thus, the camelidae family is characteristic of animals occupying remote areas, arid lands or high mountains. This is linked to the high adaptation of those species to their ecosystem. This explains the interest of this family for maintaining rural activities in the most inhospitable places of the planet [3].

Many pastoral groups and communities in diverse eco-zones throughout the world are depending on camels for their livelihood. Camel population is numerous in the arid areas of Africa, particularly in the arid lowlands of Eastern Africa namely, Somalia, Sudan, Ethiopia, Kenya and Djibouti. Those are not only kept as working animals, but also as providers of milk, meat, leather and fuel [4]. Camels are good source of low-cost meat as they provide reasonably heavy carcasses under inexpensive husbandry systems. Camel meat is mainly consumed in countries surrounding the Red Sea, such as Saudi Arabia and Jordan [5].

Ethiopia is one of the largest camel populated countries in the world with 1, 102, 119 numbers of camels that ranks third in Africa next to Somalia and Sudan, those are kept in the arid and semi-arid lowlands of the Borena, Ogaden and Afar regions, which accommodate 50% of the pastoralists [6].

Numerous studies revealed that camels are highly susceptible to certain bacterial pathogens such as *Bacillus anthracis, Mycobacterium spp, Clostridium spp, Pasteurella spp, Salmonella spp* and *Brucella spp* [1].

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Brucellosis is an infectious disease of domestic and wild animals with serious zoonotic and economic implications in humans. The disease is an important public health problem in many parts of the world [7]. Brucellosis in camels is an insidious disease, since it hardly provokes any clinical signs [8]. While brucellosis is most likely one of the oldest recognized diseases of mankind and under control in most developed countries, the containment of this zoonosis has been ignored elsewhere as it mostly affects the poor. This attitude is short sighted since the resulting medical, veterinary and socioeconomic problems are unforeseeable [9].

Camels are frequently infected with Brucella organisms, especially when they are in contact with infected large and small ruminants [10]. Brucellosis is characterized by febrile illness in humans, the disease is often difficult to diagnose solely from the clinical pictures, due to its similarities to other febrile diseases, such as malaria or typhoid fever [11].

Therefore the objectives of this review were to explain the etiology, epedimology, diagnosis, treatment of camel with brucellosis and to describe the risk factors and transmission, zoonotic importance, economic importance of camel brucellosis.

Camel Brucellosis

Etiology of Camel Brucellosis: Brucella bacteria are Gram-negative coccobacilli that are non-motile and non- spore-forming. They grow anaerobically and require media enriched with serum or blood incubated in an atmosphere of 5% to 10% carbon dioxide [12].

The disease in dromedary camels is caused by *Brucella abortus, Brucella Melitensis, Brucella suis* and *Brucella ovis*. The infection rate depends upon the infection rate in primary host animals in contact with them. This may further suggest the role of small ruminants in the occurrence of camel brucellosis [13]. The appearance of brucellosis depends on the Brucella species being prevalent in other animals sharing their habitat (Cross transmission between species) and on the husbandry system [14].

These pathogens are susceptible to the radiation of sunlight and high temperatures. Neutral Soil pH and moist environment, which is rich in organic material, are favorable elements for survival. In liquid manure, the brucella survive for months, for 22 weeks in humid feces, up to 4 months in aborted fetus and afterbirth, 44 days in the dust of streets, in tap water for 30 days, 51 days in sterile water, for 2-5 weeks in the soil of paddocks, up to 2 months in desert soil and up to 2 years in frozen soil. Moreover, the main species affecting humans are *B. abortus* (Its primary host is cattle) and *B. melitensis* (its primary hosts are goats and sheep), which cause brucellosis [15].

Epidemiology of Camel Brucellosis: The disease has a worldwide distribution and affects *cattle, pigs, sheep, goats, camelids, dogs* and, occasionally, *horses*. The infection occurs via the mucous membranes, including oral-nasopharyngeal, conjunctival and genital mucosa and also through cutaneous abrasions. The spread of brucellosis during sexual activity plays a subordinate role. Survival of the organisms in the environment is enhanced by cool temperatures and humidity; however, organisms can also survive in a hot desert environment [16]. There are so many factors that can affect the prevalence of brucellosis in various species of livestock. Prevalence of brucellosis varied according to the climatic conditions, geography, species, sex, age and diagnostic tests applied [17].

Geographical Distribution and Occurrence: In many developing countries of Asia and Africa, camels are one of the most important sources of income. Camel brucellosis can be encountered in all camel rearing countries with exception of Australia. High animal and herd prevalence have been reported from numerous countries, which not only pose a continuous risk for human infection, but also increase the spread of infection through uncontrolled trade of clinically inconspicuous animals [18]. Brucellosis was first recognized as a disease affecting humans on the Island of Malta in the early 20th century. Though its distribution is worldwide; yet brucellosis is more common in countries with poorly standardized animal and public health programme [19].

In general, brucellosis can be found in any season of the year. The epidemic peak occurs from February to July) and is closely related to the months associated with delivery and abortion in animals. In humans, prevalence of the disease is high (39.5%) in summer season [20].

Source of Infection and Method of Transmission in Camels: Animals become infected through feed, water, colostrum, contaminated milk and, especially, by licking or sniffing at placentas and aborted fetuses. The spread of brucellosis during sexual activity plays a subordinate role. The primary shedding routes of Brucella organisms remain uterine fluids (Lochia) and placenta [21].

The close contact between infected and susceptible camels in a herd promotes the spread of diseases. Most of the time, the camels are herded together with sheep and goats and to a lesser extent with cattle and they share the same watering points and pastures, increases incidence of the disease among camels [22].

Several risk factors have been identified for camel brucellosis; these are habitat level, herd size, cohabitation with other ruminants and contact with other camels. At herd level, the risk factors are herd size and cohabitation with other ruminants [23]. The prevalence is higher in intensive camel production system where large herd size kept in close proximity in a farm. In extensive management system the prevalence is low [1]. Transmission of Brucella in animals is mainly through animal contact with infected aborted material, ingestion of contaminated pastures or milk. Sexual transmission can occur through natural mating or artificial insemination [24].

Clinical Signs of the Disease: The variation of clinical symptoms which are typical for brucellosis are the consequence of the level of immunity, environmental influences, age, virulence of the pathogen and pregnancy status [25].

Camel brucellosis is characterized by lesions of lymph nodes and joint capsules, orchitis and epididymitis, inflammation of the uterus, abortion and reduced fertility. Also, many infected camels are silent carriers of brucellosis [26]. Dams can develop ovario-bursal adhesions, hydro bursitis and granulomatous endometritis. Placental retention, infertility and delayed sexual maturity have also been reported infertility in both sex [27]. The clinical signs of brucellosis in camelids are the same as those in bovines and small ruminants, although infection in camelids causes fewer abortions than it does in bovine and small ruminants [28].

Diagnosis and Treatment in Animals

Diagnosis: The majority of studies on camelid brucellosis use serological methods for diagnosis, isolation of Brucella organisms are still the preferred method of diagnosis. This method also allows typing of the isolated strains [21]. The “gold standard” in the diagnosis of brucellosis is bacterial isolation, which requires long cultivation periods. Although several polymerase chain reaction assays have been developed. Serological tests are still frequently used as diagnostic methods. The most commonly used serological screening tests are the serum agglutination test (SAT), Rose Bengal test, complement fixation test and enzymelinked immunosorbent assay [29].

Treatment: Brucella organisms are Gram‘s negative coccobacilli which are sensitive to many broad-spectrum antibiotics, but the use of antibiotics is forbidden in many countries because of the uncertainty related to the infective status of the treated animals and because of the spread of antibiotic resistance. Treatment is unlikely to be cost-efficient or therapeutically effective because of the intracellular sequestration of the organisms, mainly in the lymph nodes. A combination of oxytetracycline (25mg/kg body weight) every two days for 30 days and streptomycin (25mg/kg body weight) every two days for 16 days. In addition to this parenteral treatment, milking camels received 10 ml of oxytetracycline as intramammary infusions in each teat every two days for eight days. This regimen of treatment was effective in eliminating the shedding of Brucella organisms through milk. Using Antibiotics may be a way to save valuable animals (e.g. racing camels) from being culled [30]. Several treatment trials for brucellosis have been previously attempted but none was entirely successful. Present therapeutic trial on brucella infected camel showed long acting oxytetracycline and streptomycin combinations gave better result than the drug given alone [31].

Zoonotic Importance: Brucella species that have known zoonosis potential are *B. melitensis, B. abortus, B. suis, B. canis, B. ovis* and *B. neotamae*. The lack of hygienic measures in animal husbandry and in food handling partly account for brucellosis remaining a public health hazard. Expansions of international travel which stimulates the taste for exotic dairy goods such as fresh cheeses which may be contaminated and the importation of such foods into Brucella-free regions, also contribute to the ever-increasing concern over human brucellosis [32]. Numerous risk factors have been determined for human camel-derived brucellosis: consumption of unpasteurized camel milk and dairy products, camel ownership, assistance during nimal parturition and the presence of further infected family members [33].

Camel brucellosis has been an occupational risk for farmers, veterinary surgeons, butchers and fresh meat handlers. Brucellosis which caused by brucella species is an important zoonotic disease due to the handling of aborted materials, manipulation of reproductive excretions

with bare hands and herding of a large number of animals mixed with other animals, are widely practiced. In the North African region, as in sub-Saharan countries, social and economic factors play a major role in the spread of brucellosis [34]. While brucellosis is most likely one of the oldest recognized diseases of mankind and under control in most developed countries, the containment of this zoonosis has been ignored elsewhere as it mostly affects the poor. This attitude is short sighted since the resulting medical, veterinary and socioeconomic problems are unforeseeable [9].

Risk Factors and Transmission: Consumption of Brucella infected food e.g. milk and meat from camels has led to a high number of human brucellosis cases and is a serious public health issue. The Situation is even more grave as farmers from rural areas think that raw camel milk has healing effect for the digestive system sickness [13].

Brucella can enter the body through the lungs, the digestive tract, mucous membranes and intact skin. Once in the blood stream, the organism disseminates to multiple organs, thereby displaying an affinity for reticuloendothelial tissues, such as liver, spleen, the skeletal and hematopoietic system [35].

The inhalation is the most common mode in endemic areas, affecting farmers, herdsmen and particularly families where the animals share the same accommodation, laboratory technicians and abattoir workers, Skin (intact or broken), mucous membrane or conjunctival contact is the infection mode for abattoir workers/meat packers, veterinarians, laboratory technicians and hunters, The consumption of infected/contaminated food (Untreated milk/dairy product, raw meat), Person to person rarely (By sexual transmission, breast feeding, blood transfusion, bone marrow transplant) are main mode of transmission of brucella to man [36].

The organism can survive in the environment for up to two years under conditions of darkness, coldness and high CO_2. It is likely to be distributed by aerosol or contamination of food [37].

Clinical Signs in Man: The clinical signs of brucellosis in camels are not clearly defined. Many infected camels are silent carriers of brucellosis. Consumption of *Brucella* infected food e.g. milk and meat from camels has led to a high number of human brucellosis cases and serious public health problems. Farmers from nomadic areas believe that raw camel milk has a curative effect on the digestive system; hence this disease becomes a public health concern [38].

As humans are considered end hosts of *B. abortus* associated with a moderately severe infection, known as "Undulant fever" and *B. melitensis, B. canis and B. suis* cause the much more severe disease known as "Malta fever" [39].

People infected with Brucella often suffer from a chronic, debilitating and disabling illness. Clinical symptoms are nonspecific systemic signs and the clinical presentation of the disease are variable, the most common clinical signs are undulant fever, headache, night sweats with a peculiar odor, chills, arthralgia and weakness [40].

Brucellosis is capable of causing spontaneous abortion, congenital and neonatal infection in humans. Depending on the internal organs affected complications like spondylitis, arthritis, endocarditis, orchitis and prostatitis could be noticed [41]. Neurological complications like meningitis, encephalitis, meningo-encephalitis brain abscess, and ischemic attacks have also been occur during the onset of the disease [42].

Diagnosis and Treatment in Man: Camel brucellosis is diagnosed by combining epidemiologic history and clinical ground with Serological, bacteriological and molecular methods [43]. The standard treatment of uncomplicated cases in adults and children of 8 yrs of age and older is 100 mg doxycycline twice a day for 6 weeks plus 1g treptomycin daily for 2-3 wks.

Instead of streptomycin rifampicin may be given in combination with doxycycline (200 mg/day orally or 6 wks) at a dose of 600-900 mg for 6 wks. Treatment of complications such as spondylitis and osteomyelitis, neurobrucellosis and brucella endocarditis may require prolonged therapy for at least 8 wks. Other combinations such as cotrimoxazole plus doxcline and cotrimoxazole plus rifampin have been proposed but still need further examination [44].

Doxycycline is contraindicated for pregnant women because of possible permanent staining of deciduous teeth and inhibition of bone growth. Suggested therapies include trimethoprim-sulphamethoxazole 8/40 mg/kg/day twice daily orally for 6 weeks plus streptomycin 30 mg/kg/ day once daily intramuscularly for 3 weeks or gentamicin 5mg/kg/day once daily intravenously or intramuscularly for 7 to10 days [45].

Economic Importance of Camel Brucellosis: Camels serve as a cheap source of power for drawing water from wells, plowing and leveling land, working mini mills for oil extraction (From oil seeds), grinding wheat, corn and other grains and for crushing sugarcane and pulling carts

for the transportation of goods as well as people [46]. The economic burden arising from brucellosis in camels is associated with productivity losses (Longer calving intervals, reduced growth, increased incidences of abortion, infertility and calf mortality) and restrictions on the trade and export of animals and their products [24].

Brucellosis in animals causes tremendous economic losses due to premature birth, decreased milk production and cross transmission to other animal species. The zoonotic potential of the disease in camels should not be overlooked, despite; the advances made in surveillance and control, the prevalence of brucellosis is increasing in many developing countries due to various sanitary, socio-economic and political factors [47]. The economic impact of brucellosis can be estimated on the basis of losses due to morbidity, mortality and by estimating treatment costs. The chronic nature of the disease and the difficulties arising when treating patients must also be taken into consideration when calculating costs to local health services [48].

Status of Camel Brucellosis in Ethiopia: Among the pastoral and agropastoral communities of Ethiopia, camels are the most important livestock species uniquely adapted to live in hot and arid environments that are inhospitable to other domestic animals. Camels are traditionally raised by these communities primarily for milk production [48].

Camel brucellosis in Ethiopia is largely understudied. Initial data published on camel brucellosis in the provinces of Sidamo, Harar and Tigray reported seroprevalence of 4.4% and Afar, Somali and Borana of Ethiopia is 5.7% of seropositive with RBP and 4.2% using CFT and 2.8% in Afar by CFT [22]. In Borena lowland the seroprevalence using CFT was 1.8% [48] and in the southeast lowland areas of the Somali Region was 10.3% [49]. In Jijiga and Babile the seroprevalence was 3.18% and 2.19% respectively by using CFT [50].

Prevention and Control of the Disease: Camels possess an economic importance especially among arid and semiarid developing countries of the world. Control and eventual eradication of brucellosis depends upon strict implementation of a test and slaughter program combined with massive vaccination of the susceptible population [51]. The choice of control strategy depended on a number of considerations, such as infection prevalence in different animal species, human clinical incidence and the capacity of Veterinary Services. However, a prerequisite for any control programme was the implementation of an efficient animal disease surveillance network [52].

Introduction of hygiene procedures and correct disposal of aborted materials and the use of disinfectants [53]. A sensible intersectional collaboration between public health and veterinary sectors based on the concept of 'One medicine which would greatly improve the health status both in animals and humans [54]. Chemicals like like 70% ethanol, iodophors, formaldehyde and xylene can be used as disinfectants. Autoclaving destroy Brucella species on contaminated equipment. Treatment with antibiotic reduces mortality and decreases the amount of bacteria that appears in milk, feces, urine [55].

Intergovernmental cooperation between trading countries to prevent cross border transmission, mass testing with appropriate techniques and culling accompanied by adequate compensation (Livestock), introduction of rational vaccination schemes and application of antibiotics are the most important methods used to control camel brucellosis [56]. Because of the serious medical and economic consequences of brucellosis, serious efforts have been undertaken to prevent the infection through the use of vaccines. In Camels, both inactivated and attenuated Brucella vaccines have been used successfully. Dromedaries were vaccinated with *B. abortus* strain S19 and with *B. melitensis* Rev1 [57].

Dromedaries received the vaccine develop brucella antibodies two to four weeks after vaccination. Vaccination comes first followed by slaughter suggest whole herd vaccination in low-prevalence countries and test-and-slaughter followed by vaccination in high-prevalence countries [58]. Brucella organisms are Gram-negative bacteria which are sensitive to many broad-spectrum antibiotics, Using Antibiotics may be a way to save valuable animals (e.g. racing camels) from being culled [30].

CONCLUSION AND RECOMMENDATIONS

Camel brucellosis can be encountered and severe impact on human health in all camel rearing countries with exception of Australia. Brucellosis in animals causes tremendous economic losses due to abortion, premature birth, decreased milk production, reduced fertility and cross transmission to other animal species, the zoonotic potential of the disease in camels should not be overlooked. Due to the traditional habits of raw milk consumption, handling of aborted materials, manipulation of reproductive excretions with bare hands and herding of a large number of animals mixed with other animals,

the prevalence rate of the disease is high in pastoral communities. In the endemic countries with brucellosis, eradication can only be achieved by control, prevention and surveillance. In most countries where camels are reared they possess an important value for the owner, not only economically but also culturally. The value of dromedaries can be very high, especially for racing camels. Most of the brucellosis-positive camels are clinically healthy animals and owners do not allow their brucella serologically positive animals to be culled. Control of brucellosis in animal is the first step to control the infections to humans and the application of eradication plans are fundamental. Sanitary alsomustbemeasures carried out.

Based on the above conclusions, the following recommendations are forwarded:

- Every effort should therefore be made to increase awareness of this diseasein animal keepers, consumers of camel products, public and veterinaryhealth authorities and decision makers.
- Hygienic measures should be taken when milking; during contact with camels Strict control of illegal camel movements to different districts, regions and neighboring countries should effectively and legally impose.

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