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Review Article

Review on Epidemiology of Camel and Human Brucellosis in East Africa, Igad Member Countries

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Abstract: Camel production is expanding in pastoral areas of the Eat African region {IGAD member countries} as a result of recurrent drought and its less susceptibility to drought relative to other livestock. It is an important domestic animal and the source of milk during dry season. Camel brucellosis is prevalent in the region. From review high prevalence of human brucellosis is observed with prevalence ranging between 1 to 46.5%, 2.15 to 60%, 5.8 to 17% and 2.15 to 7.5% by ELISA, RBPT, SAT and CFT respectively; whereas 3.1 to 40.5%, 2 to 39.9% and 1.6 to 7.6% by ELISA, RBPT and CFT in camels respectively. It is transmissible from animal to humans, causing acute febrile illness, undulant fever (intermittent or remittent fever) which may persist for weeks or months accompanied by malaise, anorexia and prostration. *Brucella* species can enter mammalian hosts through skin abrasions or cuts, the conjunctiva, the respiratory tract, the gastrointestinal tract and through reproductive tracts. It has economic importance and public health hazard particularly to pastoralist community because of a widespread traditional habit of consumption of raw animal products and close contact with livestock including camels. Since brucellosis has no effective treatment both in human and livestock; vaccination, hygiene and awareness creation are the best control and prevention strategies in the region. Therefore, the objective of the seminar paper was to review-the epidemiology of brucellosis in camel and human in East Africa with emphasis on Ethiopia.

Keywords: Brucellosis, Camel, East Africa, Epidemiology, Human

1. Introduction

Livestock contribute to the livelihoods of the majority of the poor in developing countries, and has the potential to contribute to both accelerated poverty reduction and faster economic growth [1]. The member states of the Intergovernmental Authority on Development (IGAD), Ethiopia, Kenya, Sudan, South Sudan, Uganda, Somalia, Eretria and Djibouti are developing countries mainly dependent on livestock and livestock product with increased demand as result of high population growth rates and chronic food security problems [2]. Livestock provide a variety of livelihoods services to rural households, both monetary and non-monetary ones [3]. Livestock generate a regular supply of animal source food (ASF), that provides a critical supplement and diversity to staple plant-based diets [4].

Camels are important livestock in pastoral area of the region next to cattle, sheep and goats. Ecological changes, socio-cultural conditions and extensive seasonal migration have been the main driving force of becoming into camel production business in the pastoral area of region. Moreover, increased frequencies of drought recurrence, shrinkage and deterioration of the rangeland by bush encroachment together with increasing aridity are the major governing factor for the expansion of dromedary camels in pastoral areas of east Africa countries like Ethiopia (Borena) plateau [5]. This is also true in other parts of the world as dromedaries are very drought tolerant; they thrive in arid zones of many countries in the world and provide food, hides and transport. Therefore, there has developed an increasing interest in dromedary in arid countries, where other domesticated animals have difficulties to survive. Camels can graze on low productive pastures on

which the production of milk is possible and economically profitable [6].

Camels are considered to be the most important animal to be raised in pastoral area. This could be as result of camels as main source of milk during drought/dry season, ability to tolerate drought, generate high income when sale as export animals and also use as means of transportation [58]. Huge loss other livestock (cattle) occurs in pastoral areas as result of recurrent drought and climate change which forcing pastoral community to initiate camel production [5, 7]. Losses associated with camel brucellosis, indicating high economic burden to the pastoral community and on national livestock [8]. It is one of important diseases causing high economic loss. It is essentially a disease of animals, especially domesticated livestock [27]. The disease is bacterial disease caused by members of the genus *Brucella.* Bacteria of this are gram-negative, facultative intracellular, coccobacilli, non-motile and non- spore-forming bacteria [9]. It is an important zoonosis and a significant cause of reproductive losses in animals. The disease can affect almost all domestic species and cross transmission can occur between cattle, sheep, goat, camel and other species [10]. Shading bacteria by abortion is the major means of spread of organisms which can easily be acquired by susceptible animals [11]. The burden of brucellosis is greatest in low-income countries. It is a 'multiple burdens' disease with economic impacts attributable to human, livestock and wildlife disease [12, 13, 14]. It is the second most important zoonotic disease in the world, accounting for the annual occurrence of more than 500,000 human cases [15]. The disease known as Malta fever, Undulant fever, Mediterranean fever, Rock fever, Gastric fever and Contagious abortion in human, whereas Bang's disease, enzootic abortion, epizootic abortion, slinking of calves, ram epididymitis and spontaneous abortion in animals[16]. Infection prevalence in the animal reservoirs determines the incidence of human cases [17].

Camel brucellosis is a disease caused by *Brucella mellitensis* and *B. abortus* with considerable public health and economic importance to as owners consume raw milk [8]. Different studies showed that *B. abortus* and *B. melitensis* are the most frequently isolated from milk, aborted fetus and vaginal swabs of diseased camels [18, 19] and the transmission of brucellosis depends on the *Brucella* species being prevalent in other animals sharing their habitat and on husbandry [20].

The epidemiology of brucellosis in camels from different geographical locations of African and Arabian countries has been investigated extensively [19, 21, 22, 23, 24]. The prevalence of the disease in region studied showing 5.8/3.37 test conducted by RBPT/CFT [8], 11.9/7.6 by RBPT/CFT [25], 15.36% by MRT [26], 39.9/40.5 by RBPT/ cELISA and 3.9/3.1 by RBPT/cELISA [10]. Camel brucellosis caused by B. *abortus,* B. *melitensis* and B. *ovis* [18, 19]. Transmission occurs by direct contact and environmental contamination following abortion. Sexual transmission and/or artificial insemination are also important [27]. Camel diseases including brucellosis epidemiology should be known in the region to control or eradicate the disease by providing information on a disease for policy makers. This could enable pastoralists to raise healthy camel and eliminate or stop camels not to be reservoir of zoonotic disease for human infection.

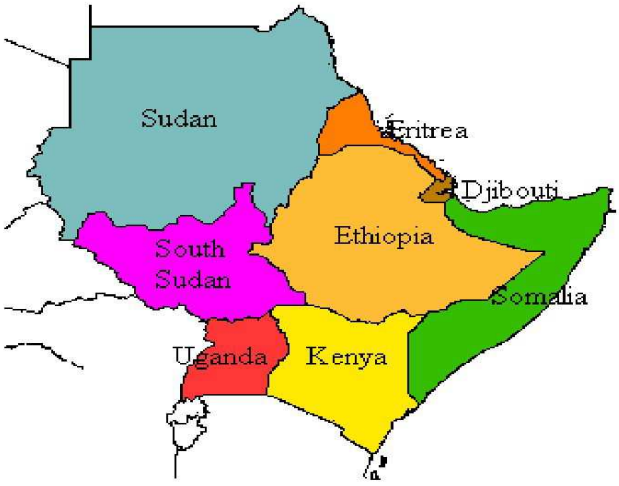
Therefore, the objectives of this review was

To review the epidemiology of camel and human Brucellosis in East Africa.

2. Literature Review

East Africa (IGAD) Member Countries

East African courtiers are developing country with both Animal and human health Problems. The Intergovernmental Authority on Development (IGAD), comprising Djibouti, Eritrea, Ethiopia, Kenya, Somalia, Sudan and Uganda, is implementing IGAD's Livestock Policy Initiative (LPI) covering area of 5.2 Million sq. km with human population of more than 180 Million (Figure 1) [1]. The countries have a development policies in common including livestock health especially on Trans boundary animal disease hindering livestock trade in the region [4]. Brucellosis in an important animal disease affecting human and animal health in the region.



Source IGAD web site www. IGAD. int

Figure 1. *East African IGAD member countries.*

3. Epidemiology of Brucellosis

Brucellosis is a worldwide bacterial zoonotic disease affecting both animals and humans. It causes serious human health hazards and economic loss [9]. It is a family of infectious and contagious gram negative coccobacilli (*Brucella abortus, melitensis, ovis, suis, canis*) that causes disease in animals and human. It is one of approximately 80 diseases that can be transmitted from animal to humans (zoonoses). The disease primarily affects cattle, sheep and goats. It also reported in, pigs, horses, Camels and humans [9, 20, 29]. The risk of *Brucella* infection is high in human which has close contact with their animals [8].

Sub-Saharan Africa poses a series of challenges that include necessary assessment of the prevalence brucellosis in humans and animals, and the influence of the various local epidemiological characteristic diseases [30]. In East African, brucellosis is reported in most of member countries and endemic with high economic loss and zoonoses [8, 12]. Brucellosis in human is common in rural areas because farmers or pastoralists live in close contact with their animals and often consume fresh unpasteurized dairy products [8, 31].

4. Epidemiology of Camel Brucellosis in East Africa

Camel milk is one of the most valuable food resources for nomads in arid regions and can contribute to a better income for pastoralists [6]. Camel milk possesses superior keeping quality to cows' milk due to its high contents of proteins that have inhibitory properties against bacteria. This makes raw camel milk a marketable commodity, even under conditions of high temperatures.

Etiology, Source of infection and Transmission of Brucellosis

Brucellosis in camels can be caused by *B. abortus, B. melitensis* and *B. ovis*. Different studies showed that *B. abortus* and *B. melitensis* are the most frequently isolated from milk, aborted fetus and vaginal swabs of diseased camels [18, 19]. The camel can get disease due to cross transmission behavior of the disease between cattle to camel; sheep to camel; goat to camel and infect camel to normal camel [10]. However, the source camel brucellosis could be determined depends on the *Brucella* species being prevalent in other animals sharing their habitat and on husbandry with camel [20]. Transmission is by contact with recently aborted animals or with food or environment contaminated by abortions or excreta. Sexual transmission is also an important means of spread and males can excrete the organisms in large numbers in their semen [27]. Camel Brucel1osis is prevalent in East Africa with prevalence ranging from 1.9-40.5% Table 1.

Table 1. *Prevalence of Camel brucellosis in East African Countries igad member countries.*

Country	No animal sampled	+VE RBPT/CFT	Test used	Prevalence %	Reference
Ethiopia	415	24/14	RBPT/CFT	5.8/3.37	Habtamu et al., 2015
	1152	58/47	RBPT/CFT	5.0/ 4.1	Angesom *et al*., 2013
	573	11/9	RBPT/CFT	2/1.6	Omer et al., 2010
	461	25	CFT	5.4	
	1100	26/21	RBPT/CFT	2.36/1.91	Sisay and Mekonnen, 2012
	768	94/58	RBPT/CFT	11.9/7.6	Wanjohi et al., 2012
Kenya	384	59	MRT	15.36%	Omer *et al*., 2010 Musa and Shigidi, 2001
Sudan	2000	750	SAT	37.5	
	2000	797/809	RBPT/ cELISA	39.9/40.5	
	3274	256	cELISA	7.82	
Eritrea	98	4	CFT	3.1	Omer *et al*., 2002
Somalia	1246	48/39	RBPT/ELISA	3.9/3.1	Ghanem *et al.,* 2009

5. Epidimiology of Brucellosis in Humans

Brucellosis in human is common in rural and pastoral areas, because farmers or pastoralists live in close contact with their animals and often consume fresh unpasteurized dairy products. In addition pastoralist handle aborted cases with bare hand which main source of the disease in the area [8].

Etiology Source, transmission of brucellosis disease

Currently, there are eleven species of Brucella causing brucellosis in different species of animal and human. The genus *Brucella* are gram-negative, facultative intracellular, coccobacilli, non-motile and non- spore-forming bacteria [9]. In human, most prevalent cause of Brucellosis is Brucella *melitensis* followed by *B. suis, B. abortus* and *B. canis.* However, other species of bacteria are also pathogenic to human [32, 33]. The key sources of brucellosis are the major food-producing animals: cattle, sheep, goats, pigs and camel [32]. The risk of disease and its severity is to a significant extent determined by the type of *Brucella* to which an individual is exposed. This will be influenced by the species of host animal acting as source of infection [27].

The possible means of acquisition of brucellosis in human include: person-to-person transmission, occupational exposure usually resulting from direct contact with infected animals, and food- borne transmission [27]. Brucellosis is transmissible from animals to humans through contaminated milk, raw milk products, meat or direct contact with infected animals [34].

Person to person transmission is rare, but it suggested being transmitted by close personal or sexual contact. Of more potential significance is transmission through blood donation/tissue transplantation, Bone marrow transfer in particular carries a significant risk [27]. Brucellosis poses an occupational risk for farmers, veterinarians, abattoir workers, laboratory personnel, and others who work with animals and consume their products [35]. These are working with farm animals, animal attendants, veterinarians, inseminators slaughter men, butchers, meat packers, processors of hides, skins and wool, renderers and dairy workers and Laboratory staff involved in culturing *Brucella* are at particular risk [27]. Human can acquire the disease from cattle, sheep, goat and camels through direct contact with blood, placenta, fetuses or uterine secretions while milking, handling infected animal fetus/placenta and other secretions [33].

This is usually the main source of brucellosis to human by ingestion of fresh milk or dairy products prepared from unheated milk is the main source of infection for most

populations [19, 36]. Undercooked meat products can also transmit the disease [36]. However, muscle tissue usually contains low concentrations of *Brucella* organisms but liver, kidney, spleen, udder and testis may contain much higher concentrations [27]. Cow, sheep, goat or camel milk contaminated with *B. melitensis* is particularly hazardous as it is drunk in fairly large volume and may contain large numbers of organisms [27, 32]. Airborne transmission of *Brucella* to humans has also been documented by inhalation of contaminated dust, contact with infected animal body fluids or tissues are other source of infection in clinical laboratories and abattoirs infection [27, 36, 37].

Table 2. *Sero prevalence humans brucellosis in East Africa.*

Country	Population	Diagnostic test (antigen/cut-off)	Prevalence %	Reference
Ethiopia	Febrile patients	Rapid slide agglutination	2.6 (653)	Animut *et al.,* 2009)
	Pastoral	*Brucella* IgM/IgG lateral flow assay	3-34.1	Ragassa *et al*., 2009
	Working with animal and product	CF T	3.6	Tolosa *et al*., 2007
	Occupational exposed people	2-MET	4.8	Kasahun *et al*., 2006
	Livestock owners	RBPT/CFT	2.15/2.15	Gebawo *et al., 2014*
Kenya	Pastoral	ELISA	2.2- 46.5	Eric *et al.,* 2015
	Working with animal and product	ELISA	1.0-9.7	Corbel, 2006
	Pastoral and agro pastoral	ELISA	13- 16	Maichomo *et al*., 2000
	febrile patients	FRDK/PCR	31.8/15.4	Setella, 2012
	Abattoir workers	STAT	10 (232)	Nabukenya *et al*., 2013; Schelling *et al*., 2013)
Uganda	locally processed milk products consumption	SAT	17	Gabriel *et al*., 2015
	cattle keepers	STAT	5.8	George *et al*., 2014
	Consumption of raw milk	cELISA	9	
Sudan	Pastoralism	RBPT	60	Omer *et al*., 2010
	abattoir workers	RPBT	9	
	Working with animal and product	cELISA	9	Nada *et al*., 2014
	Farms workers	cELISA	3.9	Nada *et al*., 2014
Eritrea	Pastoralist	CFT	3.0	Omer *et al*., 2002
	farm workers	CFT	7.5	
	Veterinary Personals	CFT	4.5	

6. Control and Prevention

Control and Prevention of camel Brucellosis

Camel gets infection from carrier animal's sheep, goat and cattle at pasture and water area. It is the same as those for the control of the disease in populations which are already infected: economic benefits and the protection of public health [27]. Brucellosis can be controlled by test and slaughter policy and Vaccination in other livestock. However, since camel is present in developing countries of pastoral areas test and slaughtering is not applicable. The decision about slaughter of test-positive animals is made after regulatory, economic and prevalence factors are considered. In most cases, test and slaughter of positive animals is only successful in reducing the incidence if the herd or flock prevalence is very low [27]. Retention of positive animals is less hazardous if the remaining animals have been vaccinated but should only be considered as a last resort. However, developing courtiers cannot afford test and slaughter approach [38].

There is general agreement that the most successful method for prevention and control of brucellosis in animals is through vaccination. While the ideal vaccine does not exist, the attenuated strains of *B. melitensis* strain *Rev. 1* for sheep and goats and *B. abortus* strain have proven to be superior to all others. No vaccine developed for control of Brucellosis in camel. However, there are good progresses of vaccine (*Brucella melitensis* Rev. 1 vaccine) development for camels with promising results [38, 39].

Control and prevention of human Brucellosis

The goal of medical therapy in brucellosis is to control symptoms as quickly as possible in order to prevent complications and relapses. Multidrug antimicrobial regimens are the mainstay of therapy because of high relapse rates reported with mono therapeutic approaches [40]. Medical therapy should be within the context of general medical supervision and, for severely ill patients, is best carried out in hospital if circumstances permit. Antibiotic treatment should be implemented at as early a stage as possible, even in patients who appear to be showing a spontaneous improvement [27].

Treatment for human brucellosis includes administration of Tetracycline (500 mg every six hours orally) administered for at least six weeks, Doxycycline (a long acting tetracycline analogue) in dose of 100gm every 12 hours orally with amino-glycoside for the first two to three weeks of therapy. Other antbiotic used for treatment are Streptomycin, Gentamicin, Rifampicin, Fluoroquinolones, Trimethoprim / sulfamethoxazole in combination with another agent, such as doxycycline, rifampicin or streptomycin [27].

Although brucellosis can be treated with antibiotics, the extended time for treatment impacts compliance, and the lack of vaccines for humans will continue to make this disease a global health threat [16]. The lack of a human brucellosis vaccine remains problematic due to the risk of *Brucella* as a possible bio-terrorist agent, and because brucellosis remains a global health problem affecting at least a half million people annually [41]. Even if the most prevalent brucella species in human is *B. melitensis* there is

no vaccine provided so far [16, 27].

7. Conclusion and Recommendations

Brucellosis is prevalent in pastoral area both in animal human in east Africa. The existing scenario of brucellosis in the region calls for urgent establishment of diagnostic laboratories both for human and animal diagnosis. In addition, regionally coordinated epidemiological diseases surveillance is urgently required together with typing of infecting strains. Typing of bacterial species in human and animal could enable to identify source of brucellosis for human. Prevention of brucellosis in humans ultimately depends on control of the disease in the animal hosts. Efforts to control brucellosis are justified economically and in terms of public health. Presence of disease in food animal predominantly indicator for infection of human by brucellosis; a single infected lactating camel can result in infection of the whole house hold due to habit of ram milk consumption in the area. According this review, consumption of raw milk, contact with aborted fetus and vaginal discharge of infected camel was risk factor for brucellosis in human. Individuals who consumed raw milk had higher odds of brucellosis sero- positivity. Consumption of raw milk of camel and other animal is common in pastoral area indicated high prevalence of brucellosis. In addition, lack of awareness on the disease made the disease occurrence more prevalent in pastoral area. Study in same area of East Africa showed that un-pasteurized milk in addition to fermented milk was common vehicles for the transmission of brucellosis from animal to human.

Therefore, base on the above conclusion the following recommendations is forwarded

(1) Brucellosis burden, species infecting human and camel should be isolated and characterized in the region.
(2) Better surveillance system and control strategies should be developed to control disease in human and animals.
(3) Awareness creation and training of community on source and way of transmission of disease need to be under taken to reduce incidence of in human the disease.

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