www.biogenericpublishers.com

Article Type: Review Article

Received: 16/06/2020

Published: 08/07/2020

Open Access Journal of Biogeneric Science and Research

ISSN 2692-1081

DOI: *10.46718/JBGSR.2020.02.000059*

Bovine Trypanosomiasis in Ethiopia: Epidemiology, Diagnosis and its Economic Impact– A Review

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Abstract

Trypanosomiasis is a worldwide disease caused by the species of the genus Trypanosoma, which affects humans, as well as domestic and wild animals. Trypanosomosis is the single most important livestock disease in Sub-Saharan Africa (SSA) and is present in 37 countries of the continent, with a range of pathologies, ranging from acute and rapidly fatal to chronic and long lasting disease depending on certain circumstances. In Ethiopia bovine trypanosomosis is the main constraint of livestock production that causes a serious economic impact on livestock production and development of the country. The most important Trypanosoma species affecting cattle in Ethiopia are Trypanosoma congolense, Trypanosoma vivax and Trypanosoma brucei. The disease is widely distributed in western and south-western parts of the country, especially in the "tsetse belt"like, omo, borena, metekel zone of Benshangul Gumuz region. The distribution of tsetse fly and related trypanosomosis in Ethiopia, is associated with the major river systems of the country; such as Abay/Didessa, Omo/Gibe, Baro/Akobo and the southern rift valley. A sound knowledge of the basic features of the various trypanosomes enables the identification of each species and the exact cause of the disease. Accurate diagnosis is a key for effective epidemiological studies, treatment and control of the disease. Several diagnostic methods can be used in the investigation of the disease. Besides clinical diagnosis, direct (parasitological), indirect (serological), and molecular diagnostic methods with varying degrees of sensitivity and specificity are available for trypanosomosis.

Keywords: Bovine trypanosomosis; Diagnosis; Economic impacts; Epidemiology; Ethiopia

Introduction

Animal trypanosomosis is an important livestock disease in Africa which is considered as a threat to the ongoing effort on poverty alleviation in the continent [1]. It is a serious disease in domestic livestock that causes a significant negative impact in food production and economic growth in many parts of the world [2], particularly in Sub-Saharan Africa [3]. Trypanosomosis affects both humans (sleeping sickness) and animals (nagana) and occurs in 37 sub-Saharan countries. Approximately 60 million people and about 50 million cattles are currently living in risk of infection [4]. The International Livestock Research Institute (ILRI) has listed trypanosomosis among the top ten global cattle diseases impacting on the poor countries [5].

Trypanosomosis is a debilitating and fatal disease of various domestic animals.It is caused by infection with the protozoan parasite of the trypanosome species, and is transmitted mainly by tsetse flies (cyclically) and other biting flies (mechanically) [6]. Trypanosomosis is a haemoprotozoan disease, mostly transmitted by the tsetse fly (Glossina spp.), it causes severe disease in humans and animals in Sub-Saharan Africa (SSA). The disease results in loss of livestock and agricultural productivity with severe socio-economic impacts. In Ethiopia, bovine trypanosomosis is widely distributed in western and south-western parts of the country. It is estimated that some 10 to 14 million heads of cattle in Ethiopia are exposed to the risk of trypanosomosis [7].

Bovine trypanosomosis is caused by fagellated protozoan parasites belong to the genus Trypanosoma. Most

African T.congolense, T. vivax and T.brucei trypanosomes are transmitted by tsetse flies [8]. Animal Trypanosomiasis of livestock, cattle known as Ghendi in Ethiopia, is one of the major diseases of livestock [9]. Trypanosomosis may be diagnosed on the basis of the clinical signs, by demonstration of the causative organism or by reactions to diagnostic tests. In some situations, the clinical manifestations of trypanosomosis, particularly anaemia may provide sufficient grounds for a tentative diagnosis. Diagnosis refers to methods for detecting infection, either by identifying the parasites themselves or by interpretation based on the results of other diagnostic tests [10].

In Ethiopia, unlike human trypanosomosis which is distributed in South-western administrative region in distribution, animal trypanosmosis is among of the most important diseases limiting livestock productivity and agricultural development due to its high prevalence in the most arable and fertile land of South West and North West part of the country following the greater river basins of Abay, Omo, Ghibe and Baro, which has a high potential for agricultural development.

Cattles are very important animals, as a source of protein (milk and meat) to humans, animal traction, income (hides) and investment (social security) and manure for enhancing agricultural (crop) production (FAO, 2005). However, Bovine trypanosomosis is one of the most prevalent and important disease in Ethiopia limiting livestock productivity and agricultural development [11]. Hence, this is to give an insight on the epidemiology, diagnostic methods and economical significance of bovine trypanosomosis in Ethiopia.

Etiology

Bovine trypanosomosis is a parasitic infection caused by an extracellular hemoparasites known as trypanosomes. Trypanosomes are unicellular protozoan parasites of phylum sarcomastigophora, order Kinetoplastida, family Trypanosomatidae, and genus Trypanosoma, Subgenus Nannomona-s (T.congolense specise), Subgenus Duttonella (T. vivax species), and Subgenus Trypanozoon (T. brucei species.) [12,13]. Trypanosomes are flagellated protozoan parasites that live in the blood and other body fluids of vertebrate hosts. They swim in body fluids by flagellum, boring their way between cells. They generally possess a kinetoplast and undergo cyclical development in an arthropod vector. Their biological adaptations, morphology and pathogenicity are fascinating and are being extensively studied [14].Three main pathogenic species of trypanosomes are recorded in Ethiopia. These are: T. congolense, T. vivax and T. brucei. T. vivax and T. congolense are the main pathogens of cattle [15] (Figure 1 &Table 1).

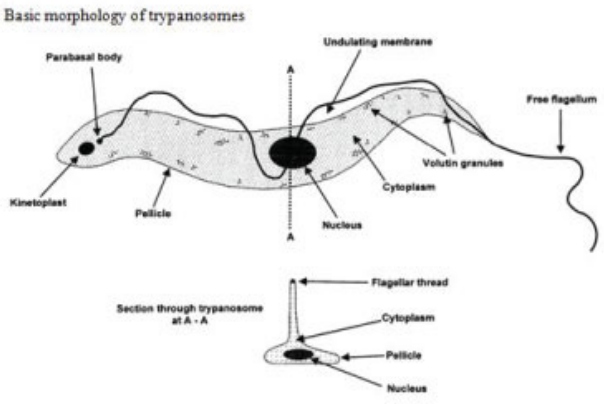

Figure 1: A Diagrammatic illustration of the fundamental features of a trypanosome as seen in a stained preparation made from the blood of an infected animal.

Table 1: Morphological characteristics of trypanosomes and site of development in tsetse fly.

Species	Site of development in tsetse fly	Free-flagellum	Kinetoplast	Undulating membrane	Size in micro meter	Size&motility in wet film
T.vivax	Proboscis	Present	Large, terminal	Not prominent	20-26	Large,extr emlyactive, traverse the whole field, very quickly, pausing occasionaly
T.brucei	Mid-gut Salivary gland	Present in all but not in stumpy	Small, subterminal, central	Prominent	15-35	Large, rapid movement in confined areas
T.congolense	Midgut, proboscis	Absent	Medium, subterminal, marginal	Not prominent	18-Sep	Small, slugish active, adheres to red blood cells by anterior end

Epidemiology

Risk Factors

Host Factors

The effect of infection varies with the host in that most wild animal and some domestic ones, establish a balance with the parasite and remain as clinically normal carriers for long periods. Some trypanotolerant breeds of cattle, indigenous to Africa can tolerate light to moderate challenge with tsetse flies by limiting the multiplication of trypanosomes in their blood and by apparently warding off the infection, especially T.vivax [16]. The level of trypanotolerance varies, depend on both genetic and environmental in origin. Cross

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breeds of indigenous Taurine and Zebu animals are also more tolerant than pure breed zebu [17]. Susceptibility of cattle to trypanosomosis depends on breed, age, behaviour, previous exposure and health status.The indigenous zebus are trypanosusceptible and West African Bos taurus breeds are trypanotolerant, i.e. they can survive and be productive without treatment under trypanosomosis risk. Exotic imported ruminants (e.g. improved dairy cattle) are more severely affected than local genotypes [18]. The four Ethiopian cattle breeds Abigar, Gurage, Horro and Sheko are related to trypanotolerance [19].

Environmental Factors

The density of tsetse population in the area and the level of their contact with the host, will determine the level of infection. Trekking of cattle through tsetse-infested vegetation is a risk, nomadic farmers faced from time to time and the risk is even greater where cattle routes converge, for example, at major bridges or watering holes [20]. Agricultural and industrial developments generally lead to a lowering of tsetse density by destroying its habitat, whereas the establishment of game or forest reserves provides large numbers of preferred hosts or a suitable habitat for tsetse, respectively. Herds located near such reserves are therefore at a higher risk [21].

Pathogen Factors

In cattle, T. vivax generally produces a higher level of parasitemia than other species. And since, its life cycle in the tsetse is also shorter; T. vivax is more readily transmitted than the others when animals are newly introduced into a tsetse infested area. Higher parasitemias also facilitate mechanical transmission. On the other hand, T. brucei is rarely detectable by direct examination of cattle blood, even though infection can be confirmed through other diagnostic methods [22].

Geographical Distribution

The epidemiology of animal trypanosomosis is determined mainly by the ecology of the tsetse fly which is found only in tropical Africa. Ethiopia is situated at the East end of the African tsetse belt and in Ethiopia, tsetse flies are confined to south western and north western regions between longitude 33° and 38 °E and latitude 5° and 12°N of an area covers 220,000 km² [23].

Bovine trypanosomosis (Nagana) is found in the low lands of Ethiopia, especially in the "tsetse belt". For example, rift valley, omo, borena, metekel zone of Benshangul Gumuz region [24]. According to NTTICC report , tsetse infested area of the Benishagul Gumuz Regional State is around 31,000 km2. The most important trypanosmes affecting cattle in Ethiopia are, Trypanosoma congolense, T. vivax and T. brcei [25]. Moreover, new areas are being invaded and settled communities are continually evicted by the advancing tsetse [26].

The general distribution of tsetse flies is determined principally by climate and influenced by altitude, vegetation, and presence of suitable host animals [27]. In Ethiopia, tsetse infested areas lied in the low lands and also in the river valleys of Blue Nile, Baro Akobo, Didessa, Ghibe and Omo. Out of the nine regions of Ethiopia five (Amhara, Beninshangul Gumuz, Gambella, Oromia and Southern Nation Nationalities and peoples region) are infested with more than one species of tsetse flies. To date five species of Glossina (Glossina morsitans submorsitans, G. Pallidipes, G. tachnoides, G. f. fuscipes and G. longipennis) have been recorded from Ethiopia [28] (Figures 2-3 &Table 2).

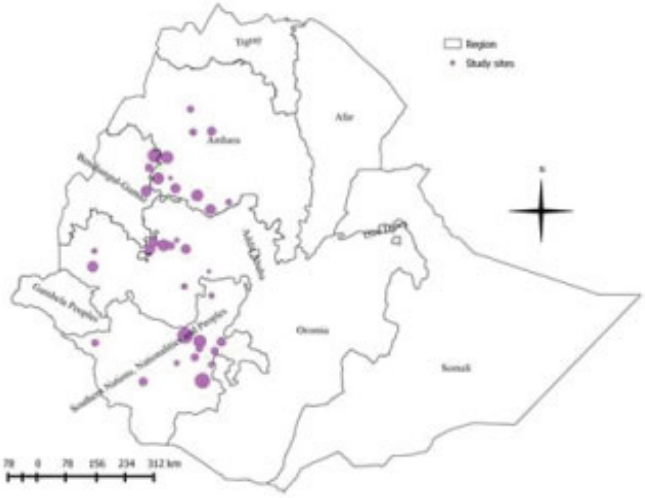

Figure 2: Observed spatial distribution of bovine trypanosomosis in Ethiopia.

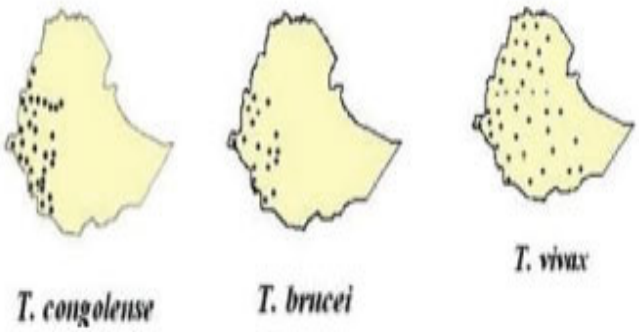

Figure 3: Distribution of pathogenic trypanosomes in Ethiopia.

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Table 2: Trypanosome species & their distribution reported in Ethiopia.

Trypanosomes	Vector	Mainly affected host	Regional distribution
T.congolense	Tsetse	Cattle	Amhara
T.vivax&T.brucei	Tsetse	Cattle	Benshangul Gumz,Gambella
T. vivax	Biting flies	Cattle	All over Ethiopia

Transmission

Bovine Trypanosomiasis can be transmitted from an infected animal to healthy ones cyclically or mechanically. The sole cyclical vectors of trypanosomiasis are the species of Glossina, which are commonly known as tsetse flies.Trypanosomosis outside "tsetse belt" is transmited by,biting (blood sucking) flies and this is known as non cyclical (acyclical) transmission. The main etiological agent of mechanically transmitted trypanosomosis is T.vivax. Unlike biological vectors, in which pathogens reproduce, mechanical vectors merely transmit pathogens, through contamination of the bite site with infected blood. The primary vector for T. congolense, T. vivax, and T. b. brucei is the tsetse fly. These trypanosomes replicate in the tsetse fly and are transmitted through tsetse fly saliva when the fly feeds on an animal [29]. Experimentally, T.vivax may also be transmitted by "syringe passage" of infective blood [30].

Diagnostic Methods of Trypanosomosis

Cinical Diagnosis (Based on Clinical Signs)

There are no pathognomonic signs that would help in pinpointing of a diagnosis. The general clinical picture is as follows but there are many variations determined by the level of tsetse challenge, the species and strain of the trypanosome, and the breed and management of the host. Acute episodes last for a few days to a few weeks from which the animal dies or lapses into a sub acute to chronic stage, or the illness may be chronic from the beginning. Chronic cases may run a steady course, may be interrupted by periodic incidents. The basic clinical syndrome appears after an incubation period of 8-20 days. There is fever, which is likely to be intermittent and to last for a long period. Affected animals are dull, anorexic, emaciation, apathetic, have a watery ocular discharge and lose condition. Superficial of severe illness, or undergo spontaneous recovery.

Lymph nodes become visibly swollen, mucous membranes are pale, diarrhea occasionally occurs and some animals have edema of the throat and underline. Estrus cycles become irregular, pregnant animals may abort and semen quality progressively deteriorates.The animal becomes very emaciated and cachectic and dies within 2-4 months or longer. Thin, rough-coated, anemic, lethargic cattle with generalized lymph node enlargement are said to have 'Fly struck' appearance. Furthermore, intercurrent bacterial, viral, or other parasitic infections may mask or complicate the basic clinical syndrome [31].

Parasitological Diagnosis

Wet Blood Film

These are made by placing a drop of blood on a microscope slide and covering with a cover-slip. The blood is examined microscopically using an x40 objective lens. Trypanosomes can be recognized by their movement among the RBC. The method is simple,inexpensive and gives immediate results. Depending on the trypanosome size and movements a presumptive diagnosis can be made of the trypanosome species [32]. Final confirmation of the species is made by the examination of the stained preparation. The diagnostic sensitivity of the method is generally low, but depends on the examiner's experience and the level of parasitaemia. Sensitivity can be improved significantly by lysing the RBCs before examination using a haemolytic agent such as sodium dodecyl sulfate [33].

Thick And Thin Blood Smears

Usually, both a thin and thick smear is made from the same sample, but thick smears contain more blood than thin smears and, hence, have a higher diagnostic sensitivity, while, thin smears allow trypanosome species identification. These methods are simple and relatively inexpensive, but results are delayed because of the staining process. Trypanosomes are easily recognized by their general morphology, but may be damaged during the staining process. This may make it difficult to identify the species [34].

Serological Tests

Several antibody detection techniques have been developed to detect specific trypanosomal antibodies for the diagnosis of animal trypanosomosis, with variable sensitivity and specificity. The aim of serological tests is to detect specific antibodies developed by the host against the infection or inversely, to demonstrate the occurrence of circulating parasitic antigens in the blood by the use of characterized specific antibodies. The detection of antibodies indicates that as there has been infection, but as antibodies persist for some times (weeks, sometimes months) after all trypanosomes have disappeared from the organism (either

by drug treatment or self-cure) a positive result is no proof active of infection. On other hand, circulating trypanosomal antigens are eliminated quickly after the disappearance of the trypanosomes and their presences therefore shows almost always that live trypanosomes are present in the animal [35].

Indirect Fluorescent Antibody Test

The test is used to detect trypanosomes antibodies. It has proven to be sesitive test but it has the disadvatage of that it can only be carried out in laboratories and the procedure is rather long and complicated as well as some extent subjective.

Enzyme Linked Immunosorbent Assay

An immunodiagnostic method based on a direct sandwich enzyme-linked immunosorbent assay (ELISA), using monoclonal antibodies, has been examined in a number of African laboratories for its suitability for monitoring tsetse control and eradication programmes. Generally, the direct sandwich ELISAs for the detection of trypanosomal antigens in serum samples have proved to be unsatisfactory with respect to diagnostic sensitivity when compared with traditional parasitological methods such as the dark ground/ phase contrast buffy-coat technique. Consequently, antigen-detection systems exploiting various other direct, indirect and sandwich ELISA systems and sets of reagents are being developed to improve diagnosis. In addition, an existing indirect ELISA for the detection of antibodies has been improved and is being evaluated in the field in order to detect cattle that are or have been recently infected with trypanosomes [36].

Molecular Test

The principle of molecular tests (DNA probes, PCR) is the demonstration of the occurrence of sequences of nucleotide which are specific for a trypanosome subgenus, species or even types of strain. Nucleotides are the constituents of DNA (deoxyribonucleic acid), the molecules which constitutes the genes on the chromosomes in the cell nucleus. A positive result indicates active infection with the trypanosomes for which the sequences are specific, as parasite DNA will not persist for long in the host after all live parasites have been eliminated. These tests are not only suitable for detecting parasites in the mammalian host, but also in the insect vector. In vitro cultivation, with species identification by techniques such as restriction fragment length polymorphism (RFLP), isoenzyme electrophoresis or DNA hybridization, is possible for some trypanosomes [37].

Polymerase Chain Reaction (PCR)

Molecular biology provides tools for sensitive and specific diagnosis based on DNA sequence recognition and amplification. The polymerase chain reaction (PCR) permits identification of parasites at levels far below the detection limit of the commonly used parasitological techniques [38]. PCR assays for trypanosome detection have been developed using species specific DNA hybridisation probes. This method requires either prior knowledge of the species to be found or the use of several probes for each sample to be tested [39].

This is another molecular method of detecting parasite DNA, and it is based on an enzyme DNA polymerase, which amplifies (multiplies, copies) sequences of DNA bases, unit sufficient material is produced to be detected. It does so by polymerization ("sticking together") of nucleic acids. This diagnosis technique is extremely sensitive, as even minute quantities of parasite and can be amplified into a detectable quantity if the number of cycles is sufficiently high. It can also be highly specific, or less so, depending on the primers available for the reaction. Some primers will amplify a piece of DNA that is specific for a subspecies, type or even strain. A large number of samples can be processed at one time, making it potentially suitable for large-scale surveys.

The most important negative aspect of this method is false-positive results may occur as a result of contamination of sample with other DNA and the test requires specialized equipments and highly trained personnel, so it is not suitable for use in many laboratories. False-negative results may also occur when the parasitaemia is very low (<1 trypanosome/ m1 of blood), which occur frequently in chronic infections; they may also occur when the specificity of the primers is too high, so that not all isolates of a particular trypanosome species are recognized (Table 3).

Economic Impacts of Trypanosomosis

In Ethiopia animal trypanosomosis, has been described as a major impediment to the livestock development and agricultural production; contributing negatively to the overall development in general and to food self-reliance efforts of the country in particular. The annual losses to the national economy are estimated to exceed US$200 million, due to its direct and indirect impact to the agricultural and livestock production. Currently, this disease and its vector (tsetse) are excluding about 180,000-220,000 km2 of agriculturally suitable land of Ethiopia, and 10 to 14 million heads of cattle, and also an equivalent number of shoats and nearly of a million equines are at risk of contracting the disease [40,41].

Trypanosomosis is among the well-known constraints

Table 3: Comparison of methods to diagnose parasite infection.

Method	Advantages	Disadvantages
DNA probe and PCR	Fast, sensetive & specific (PCR) Direct detection of parasite Can detect & differentiate variants Independent of immuno competence or previous clinical history Parasites do not need to beviable Automatable	Poor sensetive & specific(DNA probe) Expensive & Multistep Detects dead organisms Possible false-negatives from PCR inhibitors Possible false positives from Carryover contamination (PCR)
In vitro culture & mouse inoculation	Measure of virulence and Infectivity Only viable parasites detected	Expensive, Slow Interstrain variation need To Maintain parasite viability in specimen uses animals
Microscopic Examination	Simple Direct detection of parasite Can differentiate morphologically distinct organisms	Slow Laborious and tedious Requires high levels of parasite for good sensitivity can not discriminate between morphologically similar organisms Requires experienced microscopist
Serological detection of antibodies	Simple Fast Automatable Appropriate for screening large numbers of samples	Poor specificity Does not distinguish active from prioror latent infection Requires standardized reagents

to livestock production in Ethiopia as it causes a serious and often fatal disease of livestocks mainly in the rural poor community and rightfully considered as a root cause of poverty in the country. Since more than 90 percent of crop production in Ethiopia is dependent on animal draught power mainly on ploughing oxen, many large fields lie fallow due to a lack of these animals in trypanosomosis infested area, which worsens the food supply and living conditions in affected areas [42].

Trypanosomosis directly affects the milk and meat productivity of animals, reduces birth rates, increases abortion as well as mortality rates; all of these reduce the herd size and herd composition. The indirect impact of the disease mostly lies on crop production through the availability and cost of animals that provide traction power [43].

The economic benefits from intervening against bovine trypanosomosis, there is reported significant benefits especially for Ethiopia, because of its very high livestock densities and the importance of animal traction. The estimated maximum benefit per square kilometer of tsetse infested area over a 20 year period is US $10,000. Consequently, the total maximum benefits from dealing with bovine trypanosomosis in Ethiopia could be as much as US $1 billion over a 20 year period [44].

Status of Bovine Trypanosomosis in Ethiopia

In Ethiopia, significantly large numbers of works have been conducted to determine the prevalence of bovine trypanosomosis. However, the studies were limited in spatial scope and the results significantly vary between the studies. Most of the studies conducted in Ethiopia on trypanosomosis focused on tsetse transmitted trypanosomosis to determine the prevalence and impact of the disease [45]. Some states, namely Amhara, Benishanguz

Gumuz, Oromia and SNNPR contain a large number of survey locations, while other states, namely Afar and Tigray have only a few disease surveys published (Table 4).

Table 4: The mean apparent prevalence of bovine trypanosomosis in some regional states of Ethiopia.

Region	Prevalence(%)
Amhara	8.17
Benshangul Gumz	13.86
Oromiya	6.34
SNNPR	7.91

The pooled prevalence estimate varies significantly between regions, and high prevalence of bovine trypanosomosis was reported from Benishangul Gumuz regional state. The studies were conducted mainly in endemic areas for bovine trypanosomosis and non-endemic regions and remote regions may possibly be under-represented (Table 5).

Table 5: A list of the studies of , Prevalences of bovine trypanosomosis in Ethiopia: (a meta-analysis conducted on prevalence of bovine trypanosomosis between 2004 and 2014).

Author (year)	Study year	Sample size	No. positive	Apparent prevalence
Sheferaw *et al*	2014	1838	133	7.24
Birhanu *et al*	2013	493	36	7.3
Lelisa *et al*	2014	405	22	5.43
Terefe *et al*	2014	409	25	6.11
Abera *et al*	2014	384	24	6.25
Biyazen *et al*	2014	384	11	2.86
Lelisa *et al.,* 2014	2010	389	42	10.8
Tamiru *et al*	2013	436	6	1.38
Tafese *et al*	2011	386	33	8.55
Tesfaye *et al*	2009	1260	153	12.14
Fikru *et al*	2011	1524	81	5.31
Bishaw *et al*	2011	384	30	7.81
Bekele & Nasir	2011	384	33	8.6
Mekuria & Gadissa	2009	540	67	12.41
Dagnachew & Shibeshi	2009	368	33	8.97
Tadesse & Tsegaye	2009	250	11	4.4
Kebede & Animut	2008	3200	322	10.06
Miruk *et al*	2007	341	40	11.73
Mihret & Mamo	2005	3360	275	8.2
Sinshaw *et al*	2004	1509	92	6.1

Treatment, Control And Prevention

Treatment

If detected early, Trypanosomosis can be treated with trypanocidal drug for therapeutic and prophylactic purpose. Therapeutic drugs includes; diminazene aceturate, homidium bromide and homidium chloride.Prophylactic drugs for cattle include homidium bromide, homidium chloride and isometamidium [46].

Diminazene Aceturate: Have remarkable curative properties. It is very active, stable and easy to use and have

very toxicity. These advantages make it a practical and risk free trypanocides. Diminazene solution can only be kept for two to three days. It is injected subcutaneously in cattle (Slight local reactions possible) or intramuscularly (Very rapid absorption) at a dose of 3.5 mg/kg live weight for treating T. vivax and T. congolense infections. Infections due to T. brucei can be treated in cattle with the dose of 7mg/kg. Diminazene derivatives bind to DNA and interfere with parasite replications. Thisclass of drugs has tendency to accumulate in tissue, therefore half life is very long, which may lead to residual problems in food producing animals [47].

Quinapyramine Sulphate:

Quinapyramine methyl sulphate is sold in the form of white powder that dissolves easily in water. It is prescribed as a curative drug for cattle and small ruminants and is given subcutaneously as a 10% aqueous solution at dose 5mg/kg. It was used in all the African countries, giving excellent result for cattle trypanosomosis, especially T.congolense ; but it was slightly less successful against T.vivax. It causes appreciable systematic reactions and intramuscular injection cause painful local reactions leading to discomfort or lameness. Trypanosomes resistant to this compound should be treated with dimenazene.

Homidium:

Homidium salts are effective against T. vivax infections in cattle, but less effective against T. congolense and T. brucei. Their limited and protective activity in cattle depends on severity challenge and may last three to five weeks. Homidium resistant trypanosome can be controlled by diminazene or isometadium.

Isometamidium: Isometamidium is a phenanthridine aromatic amidine with a narrow therapeutic index which has been marketed for both a prophylactic and therapeutic trypanocidal agent. Isometamidium chloride is used as curatively at lower dosage rates and prophylactically at higher dosage rates. It is usually prepared as red powder easily soluble in water. It is used in a 1 or 2% aqueous solution and administered by deep intramuscular injection at the rate of 0.25-1mg/kg, depend on drugs resistant risk. Strain of trypanosomes resistant to isometamidium and other phenanthridine appear frequently, but they remain susceptible to diminazene aceturate. It is given to the animal at dose rate of 0.51mg/kg and it will be protected for two to four months depending on the extent infections risk.

Control and Prevention

The control of trypanosomosis in enzootic countries involves control of tsetse fly population, prophylactic treatment, good husbandry of animals at risk and use of trypanotolerant animals. Each of these approaches is useful but has important limitations, such as expense, environmental pollution and drug resistance.Control of tsetse has been successfully attempted, but reinvasion is frequent if the land is not properly utilized. The earliest methods involved bush clearing and elimination of game animals on which tsetse feed. More recent methods involved the use of insecticides applied strategically in the form of ground and aerial spraying over large expanses of land [48].

Conclusion and Recommendations

Trypanosomosis is one of the most prevalent protozoal diseases of cattle with greatest effects in terms of serious economic loss and pathogenic impact [49]. In Ethiopia bovine trypanomosis is highly prevalent in the low lands of tsetse infested area. Currently five regional states are directly affected by the tsetse problem. These are Amhara, Beneshangul Gumz, Gambella, Oromia and Southern Peoples Nations and Nationalities Regional State. Most studies were conducted mainly in endemic areas for bovine trypanosomosis and non-endemic regions are under-represented, that means large number of surveys were conducted mainly in the above mentioned five regions, but only a few surveys had conducted in the remaining regions of Ethiopia. Bovine trypanomosis is transmitted from the infected animal to susceptible host both by mechanical and biological vectors [50]. This disease is characterized by enlargement of lymph node, chronic emaciation and others. It can be diagnosed by clinical sign, parasitological, serological and molecular diagnostic tests. Once the infection of bovine trypanomosis is happened, it can be treat by trypanocidal drugs mainly Diaminazine aceturate and Isometamidium chloride. Bovine trypanomosis can be controlled by early treatment of infected animal, vector control and other strategies [51].

Therefore, based on the above conclusion the following recommendations are forwarded:

1. Further researches should be done on the epidemiology of bovine trypanosomosis in different regions of Ethiopia [52].

2. Awareness creation about the devastating economic impact of trypanosomosis is mandatory.

3. The national and regional veterinary laboratories should be fulfilled with sufficient laboratory equipments, reagents and specialized laboratory technicians to perform accurate diagnosis and to avoid tentative diagnosis, which

leads to drug resistance [53].

4. Restriction of cattle movement from an infected area to the disease free area to prevent and control of further expansion of bovine trypanosomosis.

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Citation: Abaynew Gelaye and Haben Fesseha. Bovine Trypanosomiasis in Ethiopia: Epidemiology, Diagnosis and its Economic Impact- A Review. Op Acc J Bio Sci & Res 2(5)-2020.

DOI: *10.46718/JBGSR.2020.02.000059*

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DOI: *10.46718/JBGSR.2020.02.000059*