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Epidemiology and Impacts of Trypanosomiasis in Cattle

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Abstract: Trypanosomiasis is a disease of domestic animals resulting from infection with protozoa of the genus *Trypanosoma,* transmitted primarily by tsetse fly and also by other haematophagous flies. Trypanosoma is a protozoal parasite that lives in blood and tissues of animals. They are unicellular organisms possessing flagellum which arises at their posterior end. Tsetse transmitted trypanosomes are widely distributed in Africa. The most important trypanosome species that affect cattle are *Trypanosoma congolense, T. vivax* and *T. brucei*. The epidemiology of trypanosomiasis considers three elements which determine presence of the diseases in a given region. These three elements are definitive host, parasites (trypanosomes) and vector (tsetse and other biting flies). Trypanosomiasis is classically acute or chronic disease that causes intermittent fever, edema, enlarged lymph nodes, decreased fertility, loss of appetite and death in chronic forms. Serological and parasitological tests are used for detection of the parasite. Those diseases which confuses with trypanosomiasis like, anaplasmosis, babesiosis and haemorhagic septicemia should be differentiated. Treatment against tyrypanosomiasis should be given early, during the initial phase of fluctuating parasitemia The common drugs which are used against trypanosomes are homidium bromide, diminazene aceturate and isometamidium chloride.

Key words: Cattle · Epidemiology · Trypanosomiasis · Tsetse fly

INTRODUCTION

Animal trypanosomiasis is disease of domestic animals resulting from infection with parasitemic protozoa of the genus *Trypanosoma* transmitted primarily by tsetse fly and also by other haematophagus flies [1]. Trypanosomiasis is the most serious in animal production mainly in sub Saharan Africa and prevents the keeping of cattle over millions of square kilometers of potentially productive land. [2]. *Glossina* species are an important African fly that act as the true vector of trypanosomiasis. Tsetse fly transmitted trypanosomiasis is commonly grouped together under the name 'nagana'. Their distribution lies within the tsetse fly belts of Africa, which extend from 14° N to 20°S in south west Africa and 29°N in Mozambique, covering an area of 10 million km^2. Many species of wild animals are symptom less carries of nagana trypanosomiasis and provide asylvatic reservoir of infection in which the trypanosomes are cyclically transmitted naturally from host to host by tsetse flies. The principal carrier of these trypanosomes are wild bovids and suids. Cattle are infected when they come in contact with these wild animal carries and bitten by infected tsetse fly as a result [3].

The epidemiology of trypanosomiasis depends on distribution of vector, virulence of parasite and response of the host. In Ethiopia trypanosomiasis is one 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 flowing the greater river basins or Abay, Omo, Ghibe and Baro with a high potential for agricultural development. Currently about 2200 km^2 areas of the above mentioned are infected with five species of tsetse flies namely, *Glossina pallidipes*, *G. fuscipes*, *G. tachinoides* and *G. longipenis* The infection of mammalian host occurs either through the bite of the infected arthropod or by contamination of the hosts mucus membrane or abraded skin by its feces. The former are called salivarian and the latter stercorarian trypanosomes. Most salivarian are pathogenic and most stercorarians are non pathogenic. The trypanosomes have

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multiple genes that code for different surface coat glycoproteins. The antigenic variation results in persistence of the organisms in the host and is a way of parasite to evade the host immune system. It also prevents the development of a vaccine and permits re infections when the animals are exposed to a new antigenic type of some trypanosomes species. This leaves tsetse control as the main method of prevention [4]. Therefore the objective of this seminar paper is to review the imperative points on the epidemiology and impact of tsetse transmitted trypanosomiasis in cattle.

Trypanosomiasis in Cattle: The presence of trypanosomiasis precludes the rearing of livestock in many areas while in others, where the vectors are not too so numerous trypanosomosis is often a serious problem, particularly in cattle. Tsetse fly transmitted trypanosomiasis are commonly grouped together under the name 'nagana', which is characterized by lymphadenopathy and anemia accompanied by progressive emaciation and often death. Glossina species are an important African fly that act as the true vector of trypanosomiasis. All trypanosomes are transmitted by tsetse flies, the main species being T*rypanosome congolense*, *T. brucei* and *T. vivax* [5].

General Features of the Trypanosomes: Trypanosomes are protozoa, belonging to the genus *Trypanosome*. They are microscopic, elongated unicellular animals that move with the help of a single flagellum directed for wards at the base of which found characteristic structure known as the kinetoplast. They multiply in the body fluids especially blood of the cattle and live in digestive tract of the biting insect. In trypanosomes, during different stages of life cycle different configurations are found which is characterized by the position of the flagellum. Amastigote (micromastigote) are small round cells which only the nucleus and kinetoplast are visible through an optical microscope. In the Promastigote stage the flagellum emerges from anterior end of the cell. The kinetoplast situated in front of the nucleus lying between it and the base of the flagellum. Epimastigote form is elongated, with the kinetoplast near to and located in front of the nucleus which is situated at the posterior end. The flagellum emerges from one sides of the body and runs along a short undulating membrane, towards the anterior end. Trypomastigote is the typical trypanosomic form. The body is elongated with a kinetoplast situated behind the nucleus; the flagellum emerges from one side of the body and runs along an undulating membrane, towards the anterior end [6].

Etiology: *Trypanosoma vivax, Trypanosoma congolense, Trypanosoma brucei and Trypanosoma simiae* are the main species responsible for Africa. The most important trypanosome species that affect cattle are *Trypanosoma congolense, T. vivax* and *T. brucei.* Trypanosome *congolense* and vivax are essential parasites of plasma although T.vivax leaves the circulation in small numbers and invade extra vascular tissues particularly of the heart. *T. congolense* has a predilection for the micro vasculature where it attaches to the endothelium and brain. *T. brucei* as well as being a plasma parasite has predilection for interstitial spaces and tissue fluids [3].

Life Cycle: Tsetse flies ingest trypanosome in the blood or lymph while feeding on an infected host. There after they lose their glycoprotein surface coat in the case of *Trypanosoma brucei* and *T. congolense*. Then they become elongated and multiply in the mid gut before migrating forward to the salivary gland in *T. brucei* and the proboscis in *T.* congolense. Then they undergo a transformation, losing their trypomastigote form and acquire an epimastigote form. After further multiplication of the epimastigotes they transform again into small, typically trypomastigote forms with a glycoprotein surface coat which is the infective form for the next host, called metacyclic trypanosomes. The whole process takes 2-3 weeks. The metacyclic trypanosomes are inoculated into the new host when the tsetse fly feeds. At site of inoculation the metacyclic forms multiply locally as the typical blood forms, producing raised cutaneous inflammatory swelling called chancre. There after enter the blood stream, multiply and a parasitemia, detectable in the peripheral blood [5].

Epidemiology and Impacts of Trypanosomiasis in Cattle: Tsetse transmitted trypanosomiasis is a wide spread devastating disease of domestic animals which is caused by microscopic protozoan organism, trypanosome. It occurs throughout area of tropical Africa, where it's found in area of tsetse fly and is considered as major constraints to livestock productivity [2]. Animal affected with trypanosomiasis become anaemic and weak. Lose of weight, reduced productivity and often mortality rates are high [1].

Epidemiology of Trypanosomiasis: The epidemiology of trypanosomiasis considered three elements that determine presence of the diseases in a given region. These three elements are definitive host (man, domestic or wild mammals), parasites (trypanosomes) and vector (tsetse and other biting flies). Understanding the role of

each factors and their relationship is based on knowledge of the ecology of the mammalian hosts and vector (habitats, distribution activity), their behavior (movements, search for food, reproduction), dynamics of trypanosome transmission and the role of parasite reservoirs (resistant or tolerant wild animals, domestic animals and the virulence of the parasite [7].

Occurrence: Trypanosomiasis are disease of all mammals in tropical Africa, central and South America of greatest economic importance in cattle [2]. Tsetse flies are confined to a belt of tropical Africa extending from the Southern Sahara (lat 5°N) in the North to Zimbabwe and Mozambique in the South (lat 20-30°S). Trypanosomes are found primarily in the tropical regions of the world. However, occasionally they may be reported in the United States. Tsetse flies inhabit wide range of habitats covering over 10 million km^2 representing 37% of the African continent and affecting 38 countries including Ethiopia [8, 9].

Vector: The vector includes several species of tsetse flies and biting flies. Tsetse flies are obligate blood sucking flies of veterinary importance because they transmit trypanosome that cause nagana in livestock. They are known to occur in the tropical and sub tropical regions of sub Saharan Africa [6]. Tsetse flies are grouped in the three categories: *Glossina morsitans* group (savanna areas), *Glossina fusca* group (forest areas) and *Glossina palpalis* group (river and lake areas). There are five species of Glossina in Ethiopia, *G. pallidipes, G. morsitans submorsitans, G. fuscipes, G. tachinoides and G. longipalpis* [10].

They occur in a variety of environment but usually found in one of three terrains. The forest (fusca group) where they inhabit thickly wooded areas with a high humidity. Riverine (the palpalis group) live on the edge of forest surrounded by streams, lakes and riverine. Savannah (the morsitans) group of tsetse flies infest large tracts of land potentially suitable for grazing and browsing by domestic livestock. Of three group of glossina species, savannah and riverine are most important since they inhabit area suitable for grazing and [3, 10].

Host: The host range of trypanosomiasis includes domestic and wild animals as well as human beings. Trypanosomiasis is basically an infection of wild life in which, by and large, it has achieved a *modus Vivendi*, in that the animal hosts are parasitemic for prolonged periods, but generally remain in good health. This situation is known as trypanotolerance. In contrast rearing of livestock in endemic areas has always been associated with excessive morbidity and mortality although there is evidence that a degree of adaptation or selection has occurred in several breeds. Thus in West Africa small hump less cattle of *Boss taurus* type, notably the N'dama, survive and breed areas of heavy trypanosome challenge despite the absence of control measure. However, their resistance is not absolute and trypanosomiasis exacts a heavy toll, particularly in productivity [5].

Transmission: The transmission of the disease is either cyclically by tsetse flies or mechanically by haematophagous flies. In cyclical transmission, the arthropod is a necessary intermediate host in which trypanosomes multiply, undergoing a serious of morphological transformations before forms infective for the next host are produced. When multiplication occurs in digestive tract or proboscis, so that the new infection is transmitted when feeding, the process is called anterior station development; the species of trypanosome which are use this process is called salivarian. In other trypanosomes, multiplication and transformation occurs in the gut and the effective forms migrate to the rectum and are passed with the faces; this process is called posterior station development. The transmission is through contamination with infective metatrypanosome forms. The trypanosome having this pattern of development and transmission are called stercorarian section.. Non cyclical transmission is essential mechanical transmission in which the trypanosomes are transferred from one host to another by the interrupted feeding of biting insects, notably *Tabanids* and S*tomoxys* [7, 11].

Epidemiology of Tsetse Transmitted Trypanosomosis in Ethiopia: In Ethiopia tsetse infested river basins are Abay, Didessa, Baro, Ghibe, Omo and Rift Valley rivers. The most important trypanosome species affecting cattle in Ethiopia are *Trypanosome congolense*, *Trypanosome vivax* and *Trypanosome brucei*. Trypanosomiasis in cattle locally referred as "Gandi" is a serious constraints to livestock production in areas of the North and South west Ethiopia. Cattle bitten by tsetse flies develop fever, anemia and progressively become weak and unproductive. Breeding animals frequently become infertile [12, 9].

Impacts of Trypanosomiasis in Cattle: The first interaction between trypanosomes and its host occur in the skin following successful feeding by an infected

tsetse fly. Within few days of bits, cattle develop a raised cutaneous swelling called a chancre which is caused by the reaction to multiplying trypanosomes. Cell degeneration and inflammatory reactions occur in many organs such as the skeletal muscles and central nervous system, but perhaps most significantly in the myocardium. Lymphoid enlargement and splenomegally development is associated with plasma cell hyperplasia and hypergamma globulinaemia, which is primarily due to an increase in Immunoglobulin M (IgM). Ultimately in infection of long duration, the lymploid organs and spleen become shrunken due to exhaustion of their cellular elements. Anemia: is a cordinal feature of the disease, particularly in cattle and initially is proportional to the degree of parasitaemia [5, 9].

Clinical Signs: Trypanosomiasis is more commonly seen as a chronic disease with intermittent fever, increasing degree of anemia and progressive loss of condition. Infected animals are restless, their coat lack luster, they lose weight, become easily exhausted and lag behind the herd, surface lymph nodes are enlarged and prominent. Cattle infected with *T. vivax* often show photophobia, excessive lacrimation, Severe emaciation and results in recumbency and death in many cases after period of 1-6 months [13].

The clinical picture of cattle suffering from nagana is influenced by several factors, namely breed and health status of cattle infected, pathogenecity of infecting trypanosomes, duration of exposure to infection and level of tsetse fly challenge, which in itself is dictated by several factors. *Trypanosoma vivax* infections in cattle in West Africa are wide spread and commonly produce an acute rapidly total disease in which affected cattle die during the initial phase of fluctuating parasitaemic. Fever, depression, dyspnoea, elevated pulse and respiratory rates, abortion and still birth may occur in pregnant cows. The situation in east Africa and parts of central Africa is different in that T*rypanosoma congolense* tends to be a more serious pathogen than *Trypanosoma vivax*. It tends to produce a chronic disease, although the clinical sign are essentially the same as those of *Trypanosome vivax* infection and eventually death is usual outcome in untreated animals. In early stage of infection appetite may be normal between periods of fever, but as the disease progress the anaemia becomes more sever, cattle become depressed and lose bodily condition and in the terminal stages affected cattle are too weak to raise or eat. Superficial lymph node enlargement is not so pronounced as in *T. vivax* infections [3]. In cattle *T. brucei* localize extravascularly and produce inflammatory reactions of the skin, subcutaneous tissue, heart, CNS and eye [14].

Diagnosis: In tsetse infected areas of Africa, nagana is well recognized and diagnosis is often based on a history of a chronic wasting condition of cattle in contact with the tsetse fly. It can be confirmed either by direct demonstration of the parasite (parasitological tests) or indirect demonstration of the parasite (serological tests) [3].

Direct Demonstration of the Parasite (Parasitological Tests): This can be generally accomplished with demonstrating parasites in the blood of infected animals. Various techniques are available like microscopic examination of the wet and stained thick and thin blood film. Thick smear dehaemoglobinized before stained with geimsa/leishman's stain, offer better chance for finding Trypanosome while thin smear for differentiation of trypanosome species. Confirmation of clinical diagnosis depends on the demonstration of Trypanosomes in the blood. Occasionally, when the parasitaemia is massive it is possible to detect motile trypanosomes in fresh films of blood. In practice, many field programs of monitoring cattle for infection are based on routine screening of stained thick and thin blood films; thick films are examined to detect infected animals and thin films to determine the species of the infecting trypanosomes [3].

In stained smear *Trypaosoma vivax* is a long, slender, monomorphic parasite with a terminal kinetoplast and a long free flagellum, but no undulating membrane. *Trypanosoma congolense* is smaller, sluggish in wet film and often adheres to red blood cells by anterior end. In stained smears, it is a short parasite with a marginal kinetoplast, no free flagellum and undulating membrane. *Trypanosome brucei* has rapid movement in confined areas of the wet film. In stained smear it is pleomorphic and may occur as long and slender forms, intermediate forms and stumpy forms. The slender and intermediate forms have a long free flagellum, pointed posterior end, sub terminal kinetoplast and a prominent undulating membrane [2].

Indirect Demonstration of the Parasite/Serological Tests: A large number of serological tests are has been used to indicate infectious with trypanosomes. The most commonly used techniques are ELIS and FAT. They have sensitivity and specificity but can only be used for the presumptive diagnosis of tyrpanosomosis [3, 13].

Table 1: Morphological characteristics of trypanosomes

Species	Free flagellum	Kinetoplast	Undulating membrane	Size (In µm)	Motility in dark ground
Trypanosome vivax	Present	Large, terminal	Not prominent	20-26	Large, extremely active, traverses with whole field quickly
Trypanosome brucei	Present	Small, sub terminal	Prominent	12-35	Large, rapid movements in confined areas
Trypanosome congolense	Absent	Medium, sub terminal marginal	-	9-18	Small, adheres to RBCs by anterior end.

Source: Kaufman [15].

Table 2: Drugs commonly used for Trypanosomiasis in cattle

Drug	Trade name	Animal	Trypanosome	Dose rates (mg/kg)	Main action
Diminazene aceturate	Berenil	Cattle	*Trypanosome congolense, T. vivax* and *T. brucei*	3.5-7.0sm/sc	Curative
Homidium bromide	Novidium	Cattle	*Trypanosome congolense T. vivax* and *T. brucei*	1.01M	Curative, some prophylactic activity
Isometamidium chloride	Samorin	Cattle	*T.congolense* and *T. vivax*	0.25-1.0 IM/SC	Curative and prophylactic drug for protection for up to 6 months

Source: Getachew and Yilma [12], Merck [17]

Differential Diagnosis: In endemic areas trypanosomosis can be confused with malnutrition, babesiosis, anaplasmosis and haemorhagic septicemia. Babesiosis is a protozoan parasite clinically which cause haemoglobinuria; urine is dark red to brown in color and produces a very stable froth. This sign is essential for differentiating trypanosomasis from babesiosis. And also the history of tick infestation is essential. In case of anaplasmosis history of tick infestation is also important. It is more acute than trypanosomasis. Haemorhagic septicemia is a bacterial disease which can be differentiated from trypanosomasis by causing inappetance followed by respiratory distress with profuse salivation and nasal discharge. In case of Malnutrition the history of feeding is more important. Thus incase of ketosis, fall of metabolic rate occur. As a result of reduction in metabolic activity, there is a fall in body temperature, pulse rate and respiratory rate [2].

Prevention and Control: The control of trypanosomiasis in enzootic countries involves control of tsetse fly population, prophylactic treatment and good husbandry of animals at risk and use of trypanotolerant animals. The recent method for controlling tsetse involves the use of insecticide (DDT and endosultan), applied strategically in the form of ground and aerial spraying over large expanses of land [2].

Two important aspects of control protect cattle from a tsetse free zone while being freckled to market through an area of endemic trypanosomiasis and an awareness of the danger of stacking a tsetse free ranch with cattle from areas where trypanosomiasis present, as mechanical transmission may cause an outbreak of disease, in both cases treatment with trypanocidal drug at an appropriate time is advisable [5].

Vector control can be achieved by various techniques like creating barrier zones, removal of tsetse habitats, artificial breeding places for the deposition of larvae of tsetse flies, chemoprophylaxis, use of trypanotolerent breeds like N'Dama cattle and animals of other west African. (Seifert, 1996). Sterize insect technique (SIT) is another technique for vector control. It exploits the particularly mating biology of tsetse where by female flies rarely mate more than once. Male flies are therefore mass reared in the laboratory, sterilized by radiation and released to mate with wild females. Females mated with sterile males are unable to produce off spring. SIT is more efficient of lower fly densities [16].

Treatment against tyrypanosomiasis, in order to be effective, should be given early in the disease during the initial phase of fluctuating parasitemia [3]. The common drugs which are used against trypanosomes are homidium bromide, diminazene aceturate and isometamidium chloride.

CONCLUSION

Trypanosomiasis is a protozoal disease occurring in many area of sub Saharan Africa including Ethiopia. It is present in the area where tsetse flies are found, mainly in savannah, riveriene and forest area. These vectors are the most important for inducing the disease which leads to the death of the animal. Trypanosomiasis occurrence depends on virulence of parasite, presence of intermediate host and the response of the host. African animal trypanosomiasis cause economic lose in case of cattle from anemia; lose of body weight and low productivity in tsetse belt area. Removal of tsetse habitats, artificial breeding places for the deposition of larvae of tsetse flies, chemoprophylaxis and use of trypanotolerent breeds like

N'Dama cattle and animals of other West African, Sterize insect technique (SIT) are some of the techniques used for vector control.

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

- Epidemiological study should be conducted for control and prevention of tsetse flies for reducing and preventing the disease.
- Use of trypanotolerant breeds such as N'dama breeds has to be encouraged to decrease the production lose due to trypanosomiasis.
- Keeping of the animal from extensive system to intensive system has to be encouraged.

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