Trypanosomiasis in southern Africa. Old challenges – new threats

Peter Van den Bossche, [1,2]Reginald De Deken [1] and Stanny Geerts[1]

[1]Institute of Tropical Medicine, Veterinary Department, Antwerp, Belgium
[2]University of Pretoria, Department of Veterinary Tropical Diseases, South Africa

Introduction

Bovine trypanosomiasis occurs in large parts of southern Africa and constitutes a severe threat to livestock production. For many years its control has been based on the control of the vector. The situation has, however, changed drastically. Budgetary deficits and minimal budgetary allocations to the veterinary departments make it impossible to allocate large sums of money to the control of tsetse. Currently, trypanosomiasis control strategies aim at maintaining a status quo in areas that were cleared of tsetse (*e.g.* western Zambia and Zimbabwe) whereas in the remaining tsetse-infested areas changes in the epidemiology of the disease will bring about new threats. Effective management of the trypanosomiasis problem is thus facilitated greatly by an understanding of the epidemiology of the disease in southern Africa and the factors affecting changes in the epidemiological circumstances.

Old challenges

Results obtained from trypanosomiasis surveys conducted in Malawi, Mozambique, Zambia, Zimbabwe and Namibia have indicated that the epidemiology of bovine trypanosomiasis follows a sequence which can be divided into four distinct epidemiological situations (Van den Bossche, 2001). Those epidemiological circumstances are a consequence of human encroachment into tsetse-infested wild areas and the subsequent gradual alterations to the environment because of clearing of vegetation and the introduction of cattle. As a result, the cycle of trypanosome transmission changes from a sylvatic cycle (tsetse and game), a combined sylvatic/domestic cycle (tsetse/game/livestock) and a domestic cycle (tsetse/livestock) into a sylvatic cycle with occasional challenge of tsetse at the game/cattle interface (Figure 1).

Sylvatic cycle (Figure 1A): This epidemiological situation occurs in the tsetse-infested game areas of southern Africa, such as the valleys of the Luangwa and Zambezi Rivers, where tsetse thrive in the absence of livestock. Obviously, in the absence of cattle, bovine trypanosomiasis does not pose a problem.

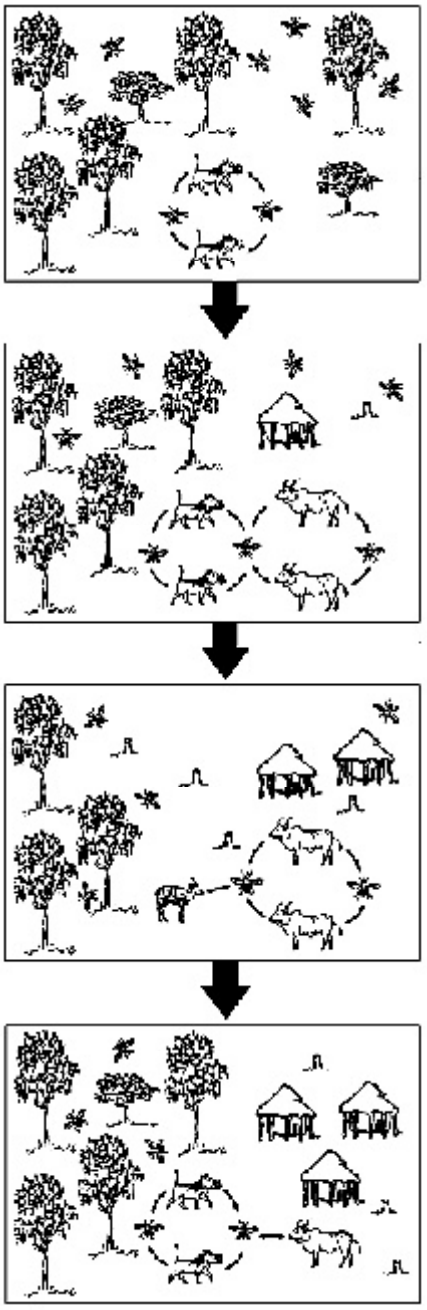

Figure 1. *The consequences of the gradual encroachment of people and cattle into a tsetse-infested area on the epidemiology of bovine trypanosomiasis (Reprinted from Van den Bossche P., Some general aspects of the distribution and epidemiology of bovine trypanosomiasis in southern Africa,* © *2001 with permission from Elsevier Science).*

Mixed sylvatic/domestic cycle (Figure 1B)**:** The change from a sylvatic to a mixed sylvatic/domestic cycle of trypanosomiasis is usually the consequence of the introduction of cattle into a tsetse-infested (game) area. Despite the presence of game, livestock will be readily fed upon and infected with trypanosomes. Since game constitute an important reservoir of trypanosome infections, cattle are likely to be challenged with a plethora of trypanosome strains including highly pathogenic ones. In such circumstances, bovine trypanosomiasis often has an epidemic character.

Domestic cycle (Figure 1C): The increasing human density and progressive clearing of vegetation reduces the density of the game. Large game animals usually disappear from such highly cultivated areas. For their survival, tsetse will have to rely mainly on cattle. Hence, the trypanosome transmission cycle changes from a mixed sylvatic/domestic cycle into a domestic cycle. This change in the epidemiological situation has important repercussions on the way in which trypanosomiasis manifests itself in the cattle. Since cattle serve as reservoir of trypanosomes, highly pathogenic strains are likely to disappear and the diversity of trypanosome strains will be limited (Van den Bossche, 2001). The disease becomes endemic with a high proportion of the cattle population infected but with limited impact on cattle production. Endemic trypanosomiasis occurs in a large part of the plateau area of eastern Zambia.

Sylvatic cycle with challenge at the game/cattle interface (Figure 1D): Finally, extensive clearing of vegetation and the concomitant elimination of suitable tsetse habitat restrict the presence of tsetse to protected areas such as game reserves, national parks and forest reserves. Game animals will again become the main host of tsetse and source of trypanosomes. Cattle will be subjected to irregular challenge along the edges of the protected areas (the interface). Because of the irregular challenge and trypanosome reservoir in

game, bovine trypanosomiasis again has an epidemic character. Currently, such interfaces are found along the Kasungu National Park and Nkhotakota Game Reserve in Malawi, along the tsetse-infested game reserves of KwaZulu-Natal Province of South Africa, along the Mamili National Park and the Kwando River in the Eastern Caprivi of Namibia.

New threats

The epidemiology of bovine trypanosomiasis in southern Africa is clearly subject to changes. It is thus conceivable that, in the years to come, those changes will have considerable repercussions on the impact of bovine trypanosomiasis and the trypanosomiasis control strategies.

Epidemics of bovine trypanosomiasis

Epidemics of bovine trypanosomiasis are expected when (i) cattle are introduced into a tsetse-infested area, (ii) previously cleared areas are reinvaded by tsetse and (iii) cattle are challenged along the game/cattle interfaces.

The introduction of cattle into tsetse-infested areas is often a consequence of resettlement and/or restocking exercises. This is the case in Matutuine District of Maputo Province of southern Mozambique where, before the civil war started in 1985, *ca.* 60 000 head of cattle were present. The war reduced the cattle density to *ca.* 600 animals. Currently, the District contains approximately 2000 head of cattle, *ca.* 6 % of the total cattle population in the Maputo Province. It has been selected as one of the zones where restocking will take place (DINAP 1998). A longitudinal study of 70, trypanosomiasis-naïve, sentinel cattle clearly showed that the recently introduced susceptible cattle were subjected to the high level of challenge (Sigauque *et al*., 2000). Over a period of 6 months, trypanosomal infections were detected in more than 50% of the sentinel animals. Taking into account the low sensitivity of parasitological diagnostic methods the incidence of trypanosomal infections is probably much higher. Unless animals are kept under a rigid prophylactic trypanocidal drug regime, such high incidence rates must have important repercussions on the productivity of the cattle that were introduced and hence the effectiveness of the restocking exercises.

Similar epidemics of bovine trypanosomiasis are expected in areas that for several years have been cleared of tsetse but are reinvaded. At the moment this occurs in the Chipinge area of the south-eastern lowveld of Zimbabwe where tsetse were eradicated following large-scale ground spraying operations. Through collective action of the governments of Mozambique, South Africa and Zimbabwe tsetse were pushed to about 60 km east of the Zimbabwe border (Robertson *et al*., 1972). Despite the absence of measures to contain the westerly advance of the fly front no trypanosomiasis cases have been reported in the lowveld since the spraying operation. Recently, however, tsetse flies were captured on the Zimbabwe/Mozambique border and bovine trypanosomiasis cases were diagnosed in the lowveld. Further spread of the disease constitutes a substantial threat to livestock production in the area.

Interfaces between cattle and game are present in every country of the region. It is likely that due to the continuous pressure for land more interfaces will be created in the future. On the plateau area of eastern Zambia, for example, cultivated areas encroach on Game Management Areas surrounding the South Luangwa National Park. Similarly, in the western region of Zimbabwe, livestock production areas encroach on the southern edge of the tsetse-infested Matusadona National Park (Van den Bossche *et al*., 2001). Notwithstanding the fact that the level of trypanosomiasis challenge along those interfaces varies considerably, its effect on cattle production is usually high (Van den Bossche, 2001).

Threat of human sleeping sickness

Game animals are the main reservoir of *Trypanosoma brucei rhodesiense*, the causal agent of human sleeping sickness in southern Africa. With the exception of South Africa, cases of human sleeping sickness have been recorded in all countries of the region. The exposure to the parasite and the threat of infection in humans is likely to increase when people come into closer contact with this wild reservoir. This will occur along the edge of tsetse-infested game areas (the cattle/game interface). At the moment, high levels of challenge occur along the edge of the Kasungu National Park and the Nkhotakota Game Reserve in the Central Region of Malawi. The area is a known human sleeping sickness focus but the incidence of the disease has increased substantially after a barrier consisting of odour-baited targets treated with insecticides was uplifted recently. Since new interfaces will be created in other parts of the region, similar epidemics of human sleeping sickness can be expected along game areas where *T. b. rhodesiense* is endemic in game such as the South Luangwa National Park. A factor that may contribute to the spread of such human sleeping sickness epidemics is the infection of cattle with *T. b. rhodesiense*. Recent studies in Uganda have demonstrated the reservoir role of cattle and their potential role in the spread of the parasite (Fèvre *et al.*, 2001). Considering the close interaction between cattle, game and tsetse along the interface, infection of cattle with *T. b. rhodesiense* is not inconceivable.

Disappearance of trypanosomiasis from endemic areas

The continuous clearing of vegetation in trypanosomiasis endemic areas will ultimately result in the eradication of the fly. This has happened in large parts of Malawi where, over the years, tsetse have disappeared from cultivated areas and are now restricted to protected game areas. More recently (between 1990 and 1997), tsetse disappeared from the Phirilongwe Forest Reserve of the Central Region (Van den Bossche *et al*., 2000). Historical and recent information on the incidence of bovine trypanosomiasis in eastern Zambia also suggest that, due to human encroachment, tsetse are likely to gradually disappear from large areas of the eastern plateau.

Development and spread of trypanocidal drug resistance

Resistance in trypanosomes to diminazene aceturate or isometamidium chloride has been demonstrated recently in Zambia and Mozambique (Eisler *et al*., 2000). Since the control of trypanosomiasis will in future rely heavily on the use of curative and preventive drugs, the spread of resistance in trypanosomes to those compounds is likely to increase.

Conclusions

Considering the above dynamics the following recommendations can be made.

Sustain achievements

Some countries in the region have achieved considerable success in clearing tsetse from extensive areas. Zimbabwe, for example, cleared more than 20 000 km^2 of land from tsetse (Lovemore, 1999). The benefits accruing from this achievement are vast. The threat of reinvasion of flies and the anticipated epidemics of trypanosomiasis in livestock should be motives to sustain those achievements and to concentrate on maintaining the effectiveness of the barriers against reinvasion.

Define area-specific livestock development guidelines

In other areas where tsetse is not controlled or that were reinvaded by the fly, control of trypanosomiasis will rely mainly on the use of preventive and curative trypanocidal drugs. The sustainability and the effectiveness of this approach will be determined largely by the livestock owner's appreciation of how animal health in general and trypanosomiasis in particular prevents him or her from achieving the objectives of the livestock production system. Under those circumstances trypanosomiasis is only one, and not necessarily the most important, constraint to livestock production. Its control has to become part of an area-specific, integrated livestock development plan developed with technical support from and advice given by animal health care providers. This may require a completely different approach towards the control of trypanosomiasis in livestock in several countries of southern Africa where tsetse and trypanosomiasis are historically dealt with by special almost independent governments departments (Vaughan-Jones, 1948). The roles and responsibilities of government will have to be redefined accordingly.

Awareness of the threat of Human Sleeping Sickness

Although most countries have a history of human sleeping sickness, the capacity to manage the problem has declined considerably. This is simply a consequence of the low incidence of the disease over the past decades and other more important human health problems at present. Furthermore, since diagnosis of human trypanosomiasis is notoriously difficult, there is a real danger that trypanosomal infections in humans will go undetected. This problem may be solved partly by creating awareness of the threat posed by tsetse flies along the game/people interface and by making appropriate diagnostic equipment available in areas where the disease poses a threat such as along the edge of the Kasungu National Park and the Nkhotakota Game Reserve in Malawi.

Monitor 'hot spots'

The emergence of tsetse in south-western Mozambique is of concern. The flies pose a considerable threat for the livestock population in the south-eastern lowveld of Zimbabwe. Moreover, tsetse could move undetected into large areas of the Gonarezou National Park and into the Kruger National Park of South Africa. This would mean the reintroduction of tsetse into an area of South Africa that has been cleared of the fly since the rinderpest epizootic at the end of the 19th century. Active tsetse surveillance in this 'hot spot' is essential.

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