

Research Article

Tick-Borne Relapsing Fever in Rural Tanzania; from a Poverty Related Disease to Travelers Disease

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Abstract

Background: Tick-Borne Relapsing Fever (TBRF) was once a major world-wide epidemic disease and was an endemic disease like malaria in Sengerema district, close to Lake Victoria, Tanzania. Our aim was to study the incidence and fatality of TBRF over the past 60 years.

Methods: From 1962 to 2015, we analyzed the annual reports, number of admissions, blood smears of patients with fever from *Borrelia* (TBRF) and malaria as controls. Furthermore, we studied the signs, symptoms and outcomes of TBRF in a prospective study during the peak incidence of TBRF, during the period 1985-1987.

Results: The average number of annual admissions in Sengerema District Hospital due to TBRF was 40 in the sixties/seventies, 200 in the eighties (range from 4 in 1962 to 455 in 1988), dropping to 30 in the nineties. The common clinical features of the disease were: fever (93%), headaches (74%), muscle- and joint pain (62%), splenomegaly (60%), and hepatomegaly (38%). Recently, over the past ten years no TBRF were recorded and no *Borrelia* spirochetes were found in blood smears.

Discussion: During the last century, we witnessed the disappearance of TBRF in Sengerema, north Tanzania. The incidence of TBRF in Sengerema district was the highest during the eighties, when borders with Kenya were closed and the economy was down after the war with Uganda. The increase of gold mining, improvement of the local economy, with improvements of housing and standards of living after the nineties, resulted in a complete reduction of the incidences of TBRF.

ABBREVIATIONS

TBRF: Tick-Borne Relapsing Fever

INTRODUCTION

During the last half of the 20th century, Tick-Borne Relapsing Fever (TBRF) was a disease of world-wide importance; it caused epidemics affecting 50 million people and was associated with death rates of 10-40%.

TBRF has been largely confined to areas of extreme poverty in East Africa and the Peruvian Andes; most cases occurred in Ethiopia. An outbreak in neighboring Sudan is estimated to have affected 20 000 people in 1998 and 1999; the death rate was 10-14% [1]. TBRF is still causing major health problems in Africa. In areas such as central Tanzania, the disease is a substantial cause of death in children [2]. TBRF is a recurrent febrile infection caused by various *Borrelia* spirochetes transmitted either by lice (epidemic relapsing fever) or by ticks (endemic relapsing fever). Clinically, these spirochetes all produce an

undulating febrile disease in humans, with signs and symptoms often indistinguishable from those of malaria. Diagnosis in most disease-endemic areas relies on demonstrating the spirochetes in Giemsa-stained blood films.

The disease affects primarily children under the age of 5-years old and men and women in the age group 15 to 30 years [3,4]. Children and pregnant women are high risk groups [5,6] and the disease takes a very serious course, responsible for a good deal of abortions, premature deliveries, maternal deaths and child deaths [7,8]. *Borrelia duttonii*, the cause of TBRF is endemic to several countries in East Africa, such as Tanzania. The vector is the soft tick, genus *Ornithodoros*; the species complex *Ornithodoros moubata* is prevalent in Sub-Saharan Africa. The ticks harboring the causative organisms hide themselves in the cracks of the walls inside houses. These ticks live in traditional housing and mainly feed nocturnally. The disease is transmitted during feeding. The tick feeds for a short period only (usually less than half an hour), then returns to the earth floor or walls of the house [1]. Nowadays, more cases of imported relapsing fever

are reported in Europe amongst tourists [9,10]. Several small villages have organized Cultural Tourism Programs that offer an alternative to safaris and a good opportunity to experience local culture. These cultural programs offer tourists the possibilities to enjoy real rural life in the small villages and sleep in mud houses with grass roofs, offering the ticks new clients to transmit the *Borrelia* with relapsing fever as the result. The aim of this study was to assess the incidence and severity of relapsing fever during the past 63 years in Sengerema, Tanzania (Figure 1).

MATERIALS AND METHODS

The annual reports of Sengerema Hospital for the past 63 years were analyzed, since the reporting of diseases were included in 1962. International Classification of Diseases (ICD 01-139) was the base of the annual reports.

I. Analysis of incidences of relapsing fever, over the period 1962 - 2015. We focused on two infectious diseases, tick-borne relapsing fever and malaria. Both TBRF and malaria are febrile diseases with diagnoses based on blood smears. The number of patients, admissions and deaths for TBRF were obtained from these annual reports, for the years 1962 - 2015. The proportion of total admissions and total deaths as well as the case fatality rates were calculated. The average of these proportions for a 10 year period was then calculated. Furthermore, a prospective study was made amongst patients with relapsing fever, during the peak-incidence of the disease in the eighties.

II. The Prospective Study of Patients seen during peak incidences of TBRF, period 1985 - 1987. Patients, who were seen or supervised by the author (PM) between December 1985 and March 1987 at Sengerema Hospital and diagnosed to have TBRF, were included. The medical history was obtained by means of a standard questionnaire and physical examination. On admission a single low dose of fortified procaine penicillin (PPF) was given followed by a full course of tetracycline's or PPF to prevent a relapse.

-Laboratory investigations: all patients, who were included, had a positive blood slide (=thick blood smear) for *Borrelia*. In all patients a *Borrelia*-Index was estimated in high power fields of each blood slide. The *Borrelia*-Index is the amount of spirochetes counted against the amount of white blood cells seen in one high power field (Figure 2). For a district hospital, Sengerema Hospital had a good standard Laboratory. In 1964, a training-school for laboratory auxiliaries was started. Several laboratory workers from other hospitals have worked for short periods to learn new techniques like bacteriology, culture and sensitivity.

RESULTS AND DISCUSSION

Data were found in annual reports between 1962 and 2015, only for a few years incomplete data was available. I. Analysis of incidences of relapsing fever, over the period 1962 - 2015. The total number of admissions, diagnosis and mortalities concerning relapsing fever during the past sixty years are presented in (Table 1). Most patients seen, are coming from Sengerema town (39%), or from within 10 miles (24%), over 10 miles but inside the district (30%) and only partly from outside the district (7%).

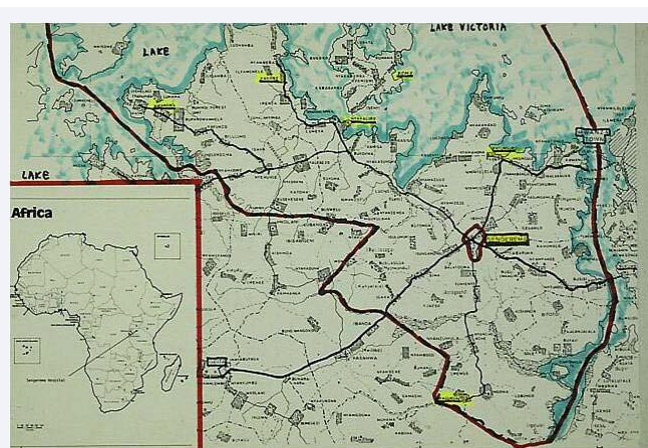


Figure 1 Africa with map of Sengerema district, north Tanzania.

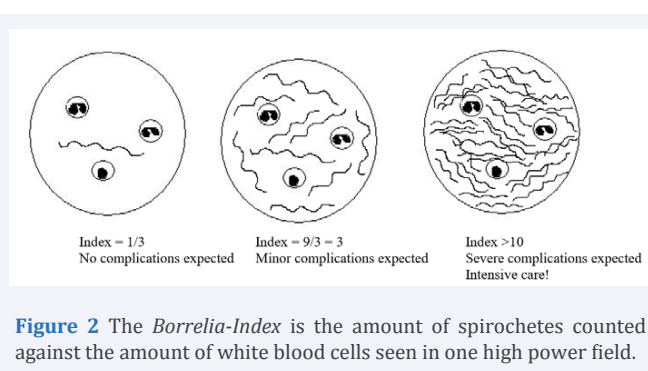


Figure 2 The *Borrelia*-Index is the amount of spirochetes counted against the amount of white blood cells seen in one high power field.

II. The Prospective Study of Patients seen during peak incidences of relapsing fever, over the period 1985 - 1987. Of the 120 patients studied, 24 were males and 96 females, all Tanzanians, their ages ranged between 1 day old and 39 years old. The symptoms and signs noted are shown in (Table 2).

Mortality due to TBRF was 10% (12/120). No fatalities due to TBRF were found in the low risk group of male adults and non-pregnant women (0/35). They all had a low *Borrelia*-Index. Mortality occurred primarily amongst pregnant women (4/51), children (5/19) and neonates (3/5). Two case reports are given as example.

Case 1, a girl of 4.5 years old, came with the history of two days fever, vomiting, abdominal pain and nausea. On examination she was ill-looking, restless, tachypnoeic and having tachycardia. Her temperature was 35.5° C. Her left eye showed a sub conjunctival bleeding. The liver and spleen were both palpable. *Borrelia*-Index: uncountable. Although therapy was started immediately, she died after one and a half hours.

Case 2, a women of 29 years old, gravida 2, para 1, was 5 months pregnant. History obtained from her relatives revealed that she had been complaining for five days of abdominal pain, fever, headaches and dizziness. On examination she was very ill with decreased consciousness, did not answer to questions, was anemic and deeply jaundiced. She had a tachypnoea of 70 times a minute, and her temperature was 39° C on admission. On auscultation there were crepitations over the right lung.

Table 1: Number of admissions of patients at the In-patient Department of Sengerema Hospital with tick borne relapsing fever.

| | Total number of hospital admissions yearly | Number of tick borne relapsing fever seen, yearly | % of admissions | Number of deaths due to relapsing fever yearly |
|-------|--|---|-----------------|--|
| 1960s | 3.500 | 30 | 1% | 2 |
| 1970s | 5.000 | 50 | 1% | 4 |
| 1980s | 7.000 | 150 | 2% | 8 |
| 1990s | 10.000 | 20 | 0,02% | 1 |
| 2000s | 14.000 | 1 | 0,001% | 0,1 |
| 2010s | 20.000 | 0 | 0 | 0 |

Table 2: Symptoms and signs on admission.

| Symptoms (%) on admission | |
|---------------------------|-----|
| Fever | 95% |
| Headache | 74% |
| Muscle pain | 62% |
| Joint pain | 64% |
| Abdominal pain | 49% |
| Nausea | 42% |
| Vomiting | 25% |
| Cough | 23% |
| Chest pain | 21% |
| Epitaxis | 15% |
| Signs (%) on admission | |
| Tachypnoea | 74% |
| Fever | 68% |
| Ill looking | 68% |
| Tachycardia | 62% |
| Splenomegaly | 60% |
| Hepatomegaly | 38% |
| Jaundice | 8% |
| Unconscious | 4% |

Palpations of the abdomen showed hepatosplenomegaly and contractions of the uterus. *Borrelia*-Index: uncountable. After some hours her temperature went down to 35° C and she died after a few more hours.

In Sengerema District, TBRF was an endemic disease. Throughout the years the diagnosis of relapsing fever was frequently made. In 1983, almost 3% of all patients admitted to the hospital had relapsing fever. The average mortality rate over these years was 4 - 10 %, which indicates that relapsing fever is a rather dangerous disease. It is noted from the patients that often they caught the disease whilest visiting relatives for a funeral and staying with them for the mourning period. In this gathering of people, beds are not available in a sufficient amount and it is then that ticks take the opportunity to infect the people lying on the ground. During such a morning the women sleep in the houses and the men outside, which might explain the fact that about twice as many women are affected than men. In the last 10 years no case of TBRF has been recorded.

The results of this study must be interpreted with care. Changes in disease frequency may be related to population changes, increased access to and use of medical facilities, increased disease recognition and variation in diagnostic patterns. It is also uncertain to what extent admission patterns truly reflect the pattern of the disease in a community where most deaths may occur at home. The trends, however, observed in this study in relapsing fever admission rates almost certainly reflects what was happening in the community. Poverty, with overcrowding and poor housing, is one of the main drivers of relapsing fever epidemics in poor communities. Poverty-related factors such as poor housing and crowding like in simple houses (grass roves) with a high tick load, increase the risk in these communities of being exposed to ticks and getting infected with *Borrelia duttoni*. It has been argued that improvement of housing and nutrition in Western Europe before the introduction of tuberculostatic drugs in the 1950s, were primarily responsible for the decline of tuberculosis incidences in this part of the world [11]. The frequency of admissions due to relapsing fever increased between 1963 and 1983 and decreased later. At the same time, the proportions of deaths due to relapsing fever decreased, probably related mainly to changes in housing and local economy (gold mining after 1980's). The increase for example in admission rates in the early 1980s correspond to a period of acute food shortage and drop in local economy throughout the country. After the eighties, Sengerema started to expand due to mining in the nearby area (Geita gold mines) and better houses were built with the booming of the local economy.

Traditionally, diagnosis is based on demonstration of spirochetes in blood films taken during the acute febrile period. By using polymerase chain reaction, even more borrelial DNA can be found, but whether this level of infection is sufficient to sustain the disease is not known [12]. In blood smears the intensity of spirochetes can be calculated and quantified in the *Borrelia*-index. There is a positive correlation between the density of the spirochaetemia and the severity of the complications. In fatal cases high levels of spirochetes are found in blood smears. More recently, an enzyme-linked immunosorbent assay was demonstrated to be a useful diagnostic aid. Furthermore, this antigen is specific for the relapsing fever group borreliae, thus distinguishing these from cases of Lyme Borreliosis (=1).

Travel-associated cases of *Borrelia* infection have been reported in Europe [13,14]. It is often associated with camping out in rural locations in close proximity to animal reservoirs of the spirochete and their associated *Ornithodoros* tick vectors. It is present in some European countries, Central Asia, the Middle East and the Americas [15-17].

Marked differences in the incidence of disease have been noted between civilian populations, who are becoming increasingly urbanized, and military populations, who have greater potential contact with rural environments during training exercises. Subsequent febrile illness is likely to be diagnosed as malaria; however, microscopic examination of Giemsa-stained blood films should show the spirochetal cause of such cases.

Relapsing fever can be acquired by travelers after eco-challenges or in association with military training or activities such as camping, even in the USA [18]. Travellers to rural areas

with high prevalence of the disease should be made aware of the risk of TBRF and the use of appropriate control measures. A diagnosis of relapsing fever should be considered in all patients returning from the tropics with recurrent fever, especially if no malaria parasites are found.

CONCLUSION

During the last century, we have witnessed the disappearance of tick-borne relapsing fever in Sengerema, north Tanzania. The incidences of TBRF in Sengerema district was at its highest during the eighties, when borders with Kenya were closed and the economy were down after the war with Uganda. Increase in gold mining activities, improvement of local economy, with improvement of housing and standards of living after the nineties, resulted in an almost complete reduction of the incidences of TBRF.

A diagnosis of relapsing fever should be considered in all travelers returning from the tropics with recurrent fever, especially if no malaria parasites are found.

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