16. TICK-BORNE RELAPSING FEVER

Tick-borne relapsing fever is nowadays an uncommon disease. Its prevalence dropped sharply when the vector kimputu was eradicated from dwellings treated with residual insecticides as part of the control of malaria.

However, the disappearance of these vectors could only be temporary, for the wild soft ticks were scarcely affected in their countless habitats. Their readaptation to human dwellings has been slowed down only by their sedentary habits. It has been proven that man and Ornithodoros moubata are the only reservoirs of Borrelia duttoni, which persists in man as a residual, latent infection. In ticks, these parasites can survive for at least fifteen years, without taking into account transovarian transmission. Renewed Borrelia attacks on humans became evident around 1975, but their origin is still unknown. Are the spirochaetes carried by wild ticks infected by latent human infections to blame, or a recolonization of the surviving domestic ticks? Should the theory of transmission from house-bound kimputus to man be challenged? These questions remain unanswered.

Borrelia antigens vary with the spirochaetes' developmental stages, and the sequences of their surface antigens can be modified. This factor can be seen when the Borrelia are cultured in fortified Kelly's medium. Such a basic event is all the more important as cross-reactions occur with trypanosomes, which are the prototypes of antigen variation.

While the symptoms of the disease are well known, the Borrelia's pantropism is a fertile field for more in-depth research using modern investigative techniques on the disease's neurological, ophthalmological and haemorrhagic complications.

Today's serological techniques have opened up new possibilities for both clinical diagnosis and sero-epidemiological surveys of man, vectors or animals suspected of playing a role in the disease's epidemiology. It may be possible, in the near future, to distinguish between initial attacks and relapses, which is a very important distinction for therapy.

Definite progress has been made in treating tick-borne relapsing fever, but there are often risks of serious side effects.
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HISTORICAL BACKGROUND

Since the 1739 epidemic observed by Rutty in Dublin, fevers with several relapses during epidemic diseases such as typhus have drawn the attention of scientists. Craigie called this disease "relapsing fever" when he observed an epidemic in Edinburgh in 1843. During the same epidemic Henderson differentiated the disease from typhus and noticed that the disease was affecting mainly the washer-women handling the linen of patients.

A new and important fact was noticed in 1857 in Africa by Livingstone. It was after a bite by a tick without eyes, at Ambaca in Angola, that he described the evolution of the disease on himself.

The causal organism was discovered in Berlin in 1868 by Obermeier, when he was doing a blood-cell count. Discouraged by Virchow he only published his observation in 1873 when he could confirm his discovery. Munch could prove in 1874 in Moscow that the spirochaete was the agent by self-inoculation, while Moschakowski (1879) could inoculate the blood of patients into healthy people.

Hinde points, in 1897, to a similar fever in the Congo (Zaire). In 1903, Nabarro had detected spirochaetes in the blood of a man from Uganda, but he postponed the publication until 1905. Ross and Mlme had published just before, in 1904, the fact that they had seen spirochaetes in the blood of eight Ugandese, and the same year Cook was describing a blood spirillum resembling S. recurrentis. Meanwhile Marchoux and Salimbenti (1903) had established in Brazil that Spirochaeta gallinarum was transmitted by Argas persicus.

However it were Dutton and Todd (1905) who demonstrated at Kasongo in Maniema that spirochaetes were present in the blood of patients with relapsing fever and that they were transmitted by Ornithodoros moubata and described the transovarian transmission of spirochaetes by this vector. Tick-borne fever was definitely identified. The circumstances that led up to this discovery are related in Todd's notebooks, which are instructive and entertaining reading (Lechat, 1964). Unfortunately, a shadow was cast on this important discovery by the tragic death of J.E. Dutton on February 27, 1906, at the age of 31. He was buried at Kasongo.

The descriptions of the course of Dutton's fatal disease, the emotional reactions to his early death and the post-mortem results cast doubts on the diagnosis of relapsing fever for such a brilliant scientist.

Independently, at the same period R. Koch described in German East Africa the life cycle of spirochaetes in the bowel, the eggs and the organs of the tick, but also their hereditary transmission.

The genus Borrelia was introduced in the order of the spirochaetes by Swellengrebel in 1907.

Tick-borne relapsing fever is found in numerous endemo-sporadic foci of the Old and the New World. The vectors are numerous local Ornithodoros varieties which have singled out variants of Borrelia. The tendency to consider that for each ornithodoros there is a Borrelia, is offset by the attempts of grouping in one batch the agent of the Hispano-African region covering the Spanish peninsula, Maghreb and West-Africa.

The hypothesis of lice as vector had its origin in the linkage between relapsing fevers and vagabonds, prisoners, refugees, or people living very close to each other and exposed to cold. Flüge formulated this opinion, but only after the experiments of Sergeant and Foley (1908) in Algeria, where a monkey was infected from lice of a patient, and after the experiments of NICOLLE, BLAIROT and Conseil (1912) was the observation on louse-transmission confirmed.

Louse-borne relapsing fever was identified in Ethiopia as early as 1896, as mentioned in the Lancet. Epidemics followed on each other very regularly, but they had only little importance in Central Africa. This relapsing fever occurred in the Sudan, at least from 1905 onwards, invading the country several times, coming from neighbouring countries. The North was invaded several times from Egypt, linked to troop movements in the Anglo-Egyptian condominium (Cummins, 1910).

In the East the Ethiopian focus was a permanent threat which struck several times the Upper-Nile province. The hinterland of Mombasa was attacked in 1942 to 1949 and these army movements were another risk for Central Africa.

In the West the disease was introduced in Darfur by workers coming from Chad and other French territories; their infection had its origin in soldiers coming from West Africa.

Nevertheless the risk is very small for lightly clothed populations accustomed to frequent washing at nearby waterpoints, and without lice.
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MAJOR CHALLENGES

1. Transmission

1.1. Agent

*Borrelia duttoni* is a highly mobile blood spirochaete of variable morphology with three to 15 coils. It stains well with aniline dyes. The longer forms are common and predominant in Central Africa. The spirochaete divides by transverse binary fission. It can be cultured on fortified Kelly’s medium (Stoenner et al., 1982); this is very useful for antigen studies.

The intermittent occurrence of spirochaetes in blood is explained by the existence and selection of variants. At least two of the so far identified surface and somatic antigens are present fairly regularly and are undoubtedly determinant, at least in man.

Besides these variations, which occur over the course of the disease, there appear to be geographically but even topographically, distinct strains. Dubois (1949a,b) identified three immunological distinct strains in three different isolated places around Butare. A plasmid has been discovered in some North American Borrelia.

1.2. Vector

*Ornithodoros moubata* or *kimputu* is a large, soft tick of the family Argasidae. These ticks have no shield on their dorsal surface and exhibit sexual dimorphism. They are xerophilic, endophilic, and very sedentary, rarely moving more than 30 metres away. Over longer distances their transport is due to man. Their sedentary habits lead to isolated occurrence in biocenoses that are compartmentalized into microfoci.

*O. moubata* is a ditropic species with night activity. It does not live on its host, attaching itself only for the time of its meals. It is not a frequent feeder; as much as two weeks may go by between meals. It feeds on blood. It becomes gorged in a few minutes and it can ingurgitate an amount of blood equivalent to about 50% of its body weight. The blood passes through the pharyngo-oesophagus into the midgut, which is divided into many dead-end diverticuli. The excess water and salt are quickly excreted by the coxal glands during the meal, thereby maintaining the tick’s water-electrolyte balance. The resulting concentrated food mass remains in the diverticuli, where it can be stored for months, even years. This explains the tick’s astonishing ability to survive without eating for long periods, even years. In this way the tick can live for up to twenty years.

Mating occurs after feeding. The fertilized female lays up to a hundred eggs at a time after each blood meal. The six-legged larvae that hatch from the eggs are inactive. They moult into asexual eight-legged nymphs in 10 to 20 days. After four to seven blood meals and consecutive molts the nymphs become adults, or sexually-mature Argasid ticks.

The domestic adult ticks burrow into the loose soil or fissures in the ground and cracks in the walls of dwellings, caravanserais, and other often ramshackle shelters for travellers, where the passing guests leave their ticks in sleeping mats or covers. When hungry these ticks will bite a newcomer. These lodgings are sources of infection in endemic areas, even if they stayed uninhabited for years.

*O. moubata* was differentiated by Walton into many subtypes, such as *O. moubata*, *O. porcinus*, subdivided at his turn into *O. p. porcinus* and *O. p. domesticus*, *O. apertus*, and *O. compactus*. The last two have no role in the disease’s epidemiology.

The role of the wild *Ornithodoros* species, which live in the burrows of warthogs, porcupines, and other mammals, in caves and hollow trees, is not clearly understood. Up to 15% of the members of these populations may carry spirochaetes (Rodhain, 1919).

1.3. Life cycle

The Borrelia ingested with the blood of an infected subject pass into the tick’s midgut. From the gut’s lumen they migrate to the enterocytes, and then to the intercellular spaces, where they considerably multiply. This new generation passes into the coelomic cavity and haemolymph. The Borrelia appear in the haemolymph a few days after the infective meal before invading various organs, the central ganglion, coxal glands, salivary glands, gonads, and Malpighian tubes.

All of the tick’s developmental stages feeding on blood can become infected and the infection persists throughout these metamorphoses. The ovaries are also invaded, causing transovarian transmission, a fact that was reported by Dutton and Todd and confirmed by R. Koch (1905). Two to 60% of the eggs are infected by spirochaetes, passing herewith to the next generation. Infection of the male ticks yields a negligible transmission rate by the sperm to only 1 to 2% of the females.

Transmission to the vertebrate host can occur as well via the salivary glands as through the coxal glands. Actually, adult *O. moubata* transmit the Borrelia primarily through their coxal fluid, which is secreted abundantly during meals. The spirochaetes
come in contact with the vertebrate host’s skin, which they penetrate through the bite site. This transmission, first observed by Todd (1903), has been studied thoroughly by Boné (1943). Direct infection via the saliva, which lubricates the mouth pieces as they pierce the skin to suck the blood, is rather rare, since the salivary glands contain very few Borrelia. In contrast, it is the rule for the nymphs, the role of which is sometimes underestimated or unknown.

Men and the domestic tick O. moubata are the reservoirs of B. duttoni. It is conceivable that, given the tick’s long life span and vertical transmission through all of its developmental stages, O. moubata constitutes the natural reservoir, so that, as a consequence, a mammalian reservoir is not indispensable (Mooser, 1963).

On the other hand, infections in man by well-adapted Borrelia to their human host can be inapparent and settle selectively in the brain tissue.

The question of residual latent infections, which means infections characterized by absence of visible clinical signs and by occult persistence of Borrelia, has not been proven. Formal proof of Borrelia’s presence is provided by inoculating suspicious tissue into a laboratory animal, although the results are controversial. This phenomenon seems to be linked to a number of factors: at first to the pathogen’s neurobiotic ability to live in symbiosis with host tissue (a property that can be acquired by passages), but also to the necessary tolerance of the host’s organs. For example, in the rabbit all of the organs except the brain are refractory to Borrelia. Following this reasoning, a latent or residual infection can become apparent if the host-parasite balance is upset, for example, by an intercurrent infection.

Nicolle and Anderson’s belief that Borrelia were originally parasites of small mammals, is not corroborated by observations on rodents and wild ticks; not a single one of those has been found to carry B. duttoni.

Minor, self-limiting infections can be produced experimentally in the dog, goat, sheep, and horse, but the porcupine is refractory.

2. Epidemiology

The foci of tick-borne relapsing fever, while confined within very precise geographical boundaries, are scattered over huge areas. The foci correspond roughly to the distribution of O. moubata.

In Zaire, this tick is found in the savanna regions of the Lower Zaire, Shaba, Maniema-Kivu, and Ituri. The northern savannas of Uele and Ubangi are not infested. This distribution corresponds to the observations made by Rodhain and Bequaerl in 1919. These two investigators mentioned the possibility of aberrant sites along the caravan routes, where forest night shelters might be infested with imported ticks.

In Burundi and Rwanda, well-defined foci occur in the mountains at altitudes of more than 2,000 metres as well as in the plains. The importance of these foci is highly variable. In one Rwandan focus near to Zaza Health Centre, 6% of the patients suffer from relapsing fever, with microscopic confirmation of some 1,600 cases each year (E. de Pierpont 1983). Most of the victims are children, but other age groups are not spared. O. moubata seems to prefer mud huts rather than the traditional straw huts.

This localized, almost household distribution of O. moubata obviates outbreaks of real epidemics. The disease is subject primarily to local resurgence that can, however, occur simultaneously in several foci.

In the 1922 Annual Report of the Public Health Department for Ruanda-Urundi, Olivier reported 298 cases, including 251 at Bujumbura Polyclinic. He noted that relapsing fever was, on the whole, fairly harmless (one death per 50 hospitalized cases), but a significant cause of morbidity in workers and soldiers. A note from Limbor (1929) confirms the practitioners’ concern.

In Bujumbura-Bubanza, Urundi, Geerts (1953) reported an average per year of 360 diagnosed cases of relapsing fever between 1948 and 1950, the year in which spraying with Gammexan was undertaken; a mere four cases were counted in 1952.

**Louse-borne relapsing fever**, which is notorious to sweep in epidemic waves across Sudan and Ethiopia, does not seem to have crossed into Zaire, Burundi, or Rwanda. Nevertheless, the presence of rather heavily louse-infested populations in the High Plateaux region, entails to pay systematic attention to the existence of B. recurrentis or to the adaptation of B. duttoni to lice. A study of louse haemolymph would not be out of place. In addition, the sharp rise in lice in Europe calls attention to the possibility of sudden, unexpected surges in human louse infestation (Rodhain, 1976).

3. Immunity

The disease produces a weak, short-lasting immunity to the local strain. The inhabitants of endemic areas are subjected to frequent re-inoculation. Therefore they display a tolerance that contrasts sharply with the serious, sometimes fatal, disease that can
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strike outsiders. It has not been proven whether this
tolerance is linked to the persistence of metacritical
spirochaetes in the brain or other refuge organs, such
as has been observed in experimental animals. The
state of premunition of inhabitants in endemic areas cor-
responds to a low stage of immunity to be kept up by
continual restimulation so as to maintain a sufficient
level of specific antibodies. It should be stressed that
the keen sense of observation of the natives in
endemic areas has led them to take a few ticks with
them when they move.

The fact that borrelioses are relapsing diseases
argues in favour of antigenic variance. The ability of a
single Borrelia to produce antigen variants has been
demonstrated by Schuhardt and Wilkerson (1951).
Cunningham (1935) and his co-workers have identi-
cified up to eight variants of B. recurrentis during
relapses. Each Borrelia strain has its own antigen
mosaic and a different number of variants.

Inherited homologous immunity, at least to
B. recurrentis, has been observed in rats born to
immune mothers. This immunity lasts for two months.
There is no proof of a similar phenomenon in pregnant
women, who abort if struck by borreliosis. Their
immunologic reaction is only seen by the occurrence of
antibodies in breast milk.

The problem of reinfection after recovery has not
been solved. Some authors think that it may be possi-
ble as early as the third month. This poses the problem
of differentiating between reinfections and relapses.
Antigen analysis may provide the answer. The first
attack is followed by the production of antibodies that
are effective only against specific variants of the strain
involved. As the infection progresses, other antibodies
specific to the relapse antigens are produced.

The Borrelia’s pantropic behaviour would appear to
indicate the persistence of Borrelia in the body caus-
ing premunition. Such premunition has been proven in
mice, but declines after ten days. Various other
degrees of cross-immunity between strains of different
origin also exist.

4. Pathology

The lesions observed are those of acute infections,
especially visceral congestion accompanied by
petechiae. The spleen may be enlarged, with infar-
tions and necrotic lesions in the Malpighian bodies.
The liver, kidneys, and myocardium show degenera-
tion without specific nature.

Meningo-encephalitis with mono- and plasmocytic
infiltration, chromatolysis of the nerve cells, and vas-
cular and perivascular changes may be seen. The
spirochaetes’ presence can also be revealed by silver
stains.

5. The disease

The course is more typical than the symptoms,
which consist of febrile paroxysms of short duration
alternating with afebrile periods lasting longer than in
malaria (five to ten days).

The onset of the febrile attacks is sudden, with few
prodromal symptoms, after an incubation period of
variable duration (two to twelve days). The patient
usually has no memory of being bitten by a vector, as
he lives with his ticks and lice.

The attack of fever is accompanied by the usual
symptoms of acute infections, chills, intense
headaches, tachycardia, myalgia in the back and
calves, arthralgia, facial congestion, injected conjunc-
tivae, subicterus, slight neck rigidity, and sometimes
the development of a rash. Marked digestive disorders
are seen as anorexia, stomach aches, vomiting, mete-
orism, tender swollen liver and spleen. This is the
blood invasion stage.

This febrile attack ends in crisis, with profuse
sweating and polyuria, around the third or fourth
day. While the following apyretic phase is symp-
tomless, the pseudo-convalescent patient remains
asthenic and depressed. The hepato- and spleno-
megaly regress.

The number and lengths of the febrile relapses are
characteristic of the disease. The average interval
between attacks is fourteen days, but can be as little as
four to seven days or stretch to three or four weeks.
The attacks can be spread over many months or, on
the contrary, be limited to only one.

The second attack begins also abruptly. The fever,
chills and assorted aches and pains can be much more
serious in a patient whose resistance is weakened by
the first attack.

The symptom complex is dominated by the dissem-
inated organ involvement due to the spirochaete’s vis-
cero-, neuro-, and oculotropism, and a haemorrhagic
syndrome in a significant number of patients. The
dominant pattern depends as well on the patient as on
the Borrelia strain involved.

The viscerotropism is seen by the development of a
rash, early but fleeting splenomegaly (F. Blanc’s
sponge spleen), lymphadenopathy, also various digestive
 disorders including vomiting and diarrhoea, and
hepatic involvement with subicterus and urobilinuria

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(40%). Hepatosplenomegaly is an almost constant feature (70%). Respiratory problems ranging from diffuse bronchitis to acute lung disease, can develop; renal failure with moderately albuminuria, myalgia, and arthralgia can occur.

The haemorrhagic syndrome can involve all of the tissues and organs. It includes petechial or purpuric exanthesma, gingivorrhagia, epistaxis (37%), digestive haemorrhages (haematemesis and melena), muscle haemorrhages (in the calves), haemoptysis, sometimes massive haematuria, and cardiovascular and haemodynamic involvement. This points to an immunopathological syndrome with disorders of vascular permeability. In the past these symptoms drew little attention, despite the fact that nosebleeds were so frequent in some areas that they were becoming almost pathognomonic. The inhabitants were more impressed by the epistaxis than by the attacks of fever, which are after all commonplace occurrences.

The possibility of the development of a transient or moderately severe consumption coagulopathy or DIC (Disseminated Intravascular Coagulation) in a Borrelia infection should be noted and investigated.

Nervous disorders are not rare. The neuro-meningeal syndrome occurs most often during the second or third attack. It manifests itself with severe headache, prostration, sometimes a positive Kernig's sign, vertigo, and transparent CSF however with strong lymphocytosis and elevated protein titre. Convulsions occur in children. There is sometimes involvement of the peripheral nerves, but the cranial nerves (common oculomotor, trigeminal, facial, and acoustic nerves) are the most often involved, causing strabismus, blepharoptosis, trigeminal neuralgia, and deafness.

Spinal cord involvement may cause flaccid or spasmodic paraplegia. Encephalitis gives rise to various disorders, including mental disorders such as anxious agitation, excitation, confusion, onirism and delirium.

The eyes are frequently affected. B. duttoni has a predilection for the iris and choroid. Infection of the optic nerve, especially retrobulbar involvement can develop causing blindness.

The course of the Borrelia infection is not constant. In 25% of the cases the disease is inapparent, abortive, benign, ambulatory, purely febrile, or limited to a single attack. Other causes of febrile attacks can cloud the clinical picture in a plethora of symptoms making it difficult to pick out which is really the cause responsible for an occurring disorder.

The problem of congenital borreliosis cannot be ignored, especially since it can be fatal. Of course, one must keep in mind that the incubation time can be as little as three days. As a result, if the spirochaete is detected after a longer interval after delivery, one cannot exclude with any certainty the possibility of infection during the delivery itself or by a tick bite. On the other hand the placenta, which is permeable to the mother's red blood cells, cannot be an effective barrier against the Borrelia's passage from the mother's blood. Cases of congenital tick-borne relapsing fevers have indeed been reported in Africa.

Finally, one should keep in mind the real risk of Borrelia transmission via blood transfusions while transfusion services are expanding. Hira and Hussein (1979) have stressed that these fears are substantiated in Zambia.

6. Diagnosis

6.1. Clinical diagnosis

This is easy only when there is a classic temperature curve, which by definition occurs only in a late phase, even after the fever. In endemic areas, some elements with presumptive value may draw the examiner's attention: unbearable headaches, epistaxis, neurotropism, prostration, and hyperaemia of the optic disc.

First and foremost the disease must be distinguished from malaria, especially since these two diseases can and often do coexist. The first febrile attack may be common to the point of being mistaken for flu. Jaundice, if manifest, raises the problem of differentiating the disease from viral hepatitis, yellow fever and leptospirosis. Often one should think of the possibility of Sodoku or rickettsioses, and of a large variety of arbovirus infections.

6.2 Laboratory analysis

Diagnosis by laboratory analyses relies on the detection of Borrelia in the blood, in CSF, even in urine. During an attack the spirochaetaemia may be as high as 300,000 spirochaetes/mm³.

The thick film is the simplest technique, provided that one remembers that Borrelia are difficult to stain. Wright's or a prolonged Giemsa stain should be used, followed if necessary by staining with 1% crystal violet for 10-20 seconds. When there is no thick film, one must examine the end of the blood smear very carefully. It is possible to detect the Borrelia in fresh blood by darkfield or phase contrast microscopy. Using acridine orange and the fluorescence microscope is a very sensitive method.

In the case of a specific lung pathology, the Borrelia can be detected in the sputum. An in vitro culture
technique has been developed recently using fortified Kelly’s medium.

If the Borrelia are rare, they can be concentrated using an anion exchange column made of Diethylamino-ethylcellulose (DEAE). Intraperitoneal inoculation into young or newborn mice allows diagnosis after four to seven days’ incubation. Such inoculation is necessary to detect Borrelia in the CSF.

The spirochaetes are also found in the bone marrow. Haematological examination will reveal anaemia, polymorphic hyperleucocytosis, and thrombocytopenia (93%). Checking for haemostasis should not be overlooked. The prothrombin time (PT) and partial thromboplastin time (PPT) are lengthened. The fibrin-fibrinogen degradation product (FPDP) have a high titre. Coagulation is normal.

In the CSF proteins and lymphocytosis are elevated. Borrelia may be present, but are rarely detected on direct examination.

SEROLOGICAL tests may be useful, but the multiplicity and heterogeneity of the strains limit their value. The antigens must be prepared from local strains.

The most useful tests are:
- agglutination, backed up by a control to eliminate the very frequent phenomenon of self-agglutination;
- immobilization followed by lysis;
- complement deviation at titres of 1:25 to 1:100;
- indirect immunofluorescence and ELISA, which seem to be the most promising techniques as they are linked to strain specificity.

It should be kept in mind that Borrelia can cause agglutination of Proteus OXK at titres as high as 1:800.

7. Treatment

Antibiotics have taken the place of arsenic compounds, which were useful in the past, but often toxic.

Penicillin is active against Borrelia at the dosis of 3 to 5 mega-units IM of procaine penicillin; it is recommended either in a single dose or in ten consecutive daily doses. These differences in huge dosage stem from the fact that the stage of infection (either first invasion or late relapse) is all too frequently not known. The late relapse, which is common in the tropics, combined with premonitory against local strains, is controlled easily by single low doses.

Ampicillin is given orally with the dose of 500 mg. Streptomycin is active but should be considered a second choice because of its side effects.

The tetracyclines are the treatment of choice. They should be selected on the basis of their cost. Chlortetracycline (Aureomycin) and oxytetracycline (Terramycin) are used in daily doses of 1.5 to 2 g for five, seven, or ten days, but 500 mg of tetracycline or erythromycin in one or two doses has proved just as effective. Doxycycline (Vibramycin®) minocycline (Minocyn®), and tetracyclines which have longer half-lives, are given in single doses of 100 or 200 mg. This dose may occasionally have to be repeated for two to three days (Perine et al., 1974; De Clercq et al., 1975).

The risk of a Jarisch-Herxheimer reaction due to the sudden lysis of a large number of spirochaetes and the massive release of endogenous pyrogens is real. In such cases, the patient complains only a few hours after the administration of a specific drug (one hour after IV injection) of headaches, chills and erythema (possibly urticarial), and will eventually go into shock. To ward off this danger, the cure should be initiated with a slow-clearing penicillin prior to the administration of tetracycline, which causes sudden, massive lysis of Borrelia.

8. Prevention

Preventing borreliosis means tick control measures. One tactic is to eradicate or reduce the number of ticks in dwellings by eliminating their niches in and around human habitations by occluding the cracks in walls and pavements with stucco, cement or tar.

Dusting with a wettable insecticide powder (HCH, lindane, or dieldrin) is another classic approach. Trials conducted in Bujumbura in which the first 10 cm of the earth floors of each hut were loosened and mixed with insecticide before being packed down again, were highly successful with the population’s active participation (Geerts, 1953).

A zone around the huts can also be cleared to reduce the number of rodents or other wild mammals in the area with flumetrin or deltametrin, carbaryl at 0.17% in aspersin or fumigation with methylbromide (20 g·m⁻³). The use of repellents such as DEMT (di-ethyl-meta-toluamide), di-methyl-phtalate, may also be useful for individual protection.
9. Questions for further study

Tick-borne relapsing fevers continue to raise a great many questions:
- the close relationship between O. moubata and B. duttoni is even tighter than indicated by the saying “one area, one Borrelia species”, for the spirochaetes’ mosaic of antigens differ in microfoci that are barely a few kilometres apart;
- the antigen determinants and sequences of the strains originating in different microfoci must be studied if we are to improve our knowledge of the epidemiology of tick-borne relapsing fever;
- the pathogenicities of the specific strains must be determined in laboratory animals; this will make it possible to identify strains with specific tropisms as for example, the degree of neurotropism;
- the identities of the wild and domestic Ornithodoros species must be established by simple, reliable parameters;
- does B. duttoni really lack an animal reservoir, whereas such reservoirs are almost the rule for other species?
- what is the epidemiological context that determines an evolution towards high endemicity or to sporadic clinical cases?
- the role of undernourishment and of poor general hygiene in the clinical evolution of the disease should be elucidated.

The foregoing statement also applies to interference with rickettsial diseases and sleeping sickness.

P.G. Janssens

BIBLIOGRAPHY


Tick-borne relapsing fever is frequent in eastern Rwanda, where it is an important cause of miscarriages (33% risk) and perinatal maternal mortality (16%). The density of spirochaetes in pregnant women is higher than in other women. Treating with penicillin alone is not sufficient. The authors propose that penicillin should be administered systematically with chloroquine to all pregnant women with fevers, followed by a single dose of tetracycline once relapsing fever has been diagnosed.


The resurgence of tick-borne relapsing fever in Rwanda since 1975 (although it seemed to have been eradicated from this country for some 15 years as a side effect of antimalarial spraying of homes) has given investigators a chance to examine a series of problems that this disease continues to raise. These include identifying the surface and somatic antigens of the various Borrelia species, determining their roles in relapses and elucidating the corresponding sero-epidemiological patterns. The respective roles of the classic domestic vector, Ornithodoros moubata, and wild ticks that may be infected by possible reservoir animals in the disease’s transmission and the possibility of passage in lice must be elucidated. The disease process itself and the presence of Borrelia in “safe haven” organs call for further study. The same goes for the mechanisms of the haemorrhagic component of the disease and the Jarisch-Herxheimer reaction following treatment.