Schistosomiasis mansoni in Burundi: progress in its control since 1985

D. Engels, J. Ndarimpa, & B. Gysels

Described is the evolution of the schistosomiasis control programme in Burundi since 1985. A single round of selective chemotherapy was carried out in the Rusizi Plain and the Bugesera foothills of Burundi, from 1985 to 1990. The prevalences and intensities of infection as well as the number of symptomatic cases treated in general health services decreased considerably. Annual sample surveys in the treated areas showed, however, that these improvements were rapidly reversed by reinfection of the demographically changing population. Since repeated selective population chemotherapy was not sustainable in the long term, a primary health care approach was adopted. In areas with good access to basic health services, approximately 10% of all schistosomiasis cases now receive treatment annually through this approach. Yearly selective chemotherapy in primary schools in suburban Bujumbura reduced the prevalence of schistosomal infection among pupils from 23% to 9% over the period 1984-90, and this programme has now been extended to highly endemic areas in Imbo-Sud. Focal snail control produced disappointing results, and emphasis has therefore shifted towards health education and environmental control of transmission.

Introduction

In Burundi, intestinal schistosomiasis caused by Schistosoma mansoni is essentially a man-made problem: land reclamation, agricultural development, and human settlement have largely contributed to its spread since the 1950s. The history of schistosomiasis in Burundi and the development of a control programme based on extensive epidemiological and operational studies have been reviewed elsewhere. The present article presents an overview of this programme since its implementation in 1985 as well as the resulting shifts in control strategy.

Burundi is a small (area: 28,000 km²) but densely populated country (1990 census population: 5.3 million). The centre of the country consists of highlands (altitude: 1500-2000 m), which towards the west form mountains of height up to 2600 m. The highlands are surrounded by lowland areas (altitude: 700-1400 m): the Imbo Plain in the west, the Bugesera depression in the north, and the Moso Plain in the east (Fig. 1). Schistosomiasis is currently confined to these lowlands.

Fig. 1. Maps of Burundi as a whole and of the three major rural areas endemic for schistosomiasis. Popu-

lation risk was: Rusizi Plain = 180 000; Bujumbura = 130 000; Imbo-Sud = 160 000; Bugesera = 70 000; and Moso = 200 000. Shaded circles: <5 km from a health centre.

The Control of Schistosomiasis

Second Report of the WHO Expert Committee

This report provides a comprehensive guide to the technical and practical factors that need to be considered when designing and implementing programmes for the control of schistosomiasis. Noting the success of strategies focused on morbidity control, the report shows how the spectrum of programme goals can now be broadened to include reductions in the prevalence and intensity of established infections and decreases in the intensity of transmission. Throughout, emphasis is placed on knowledge and experiences that can help programme managers establish the feasibility of control options in line with the form of infection, its public health importance, the degree and type of morbidity, available resources, and integration into the primary health care system. Information is specific to the different types of schistosomiasis and the distinctive epidemiological features, clinical manifestations, and response to treatment of each.

The report has three main parts. The first, which is devoted to strategies for control, provides a concise, yet complete review of all factors that need to be considered when establishing priorities and deciding on the most appropriate options for control. Emphasis is placed on the many recent advances, including experiences with praziquantel, that have strengthened the tools available for prevention, diagnosis, treatment, and cure. Programme managers are given advice on how to assess the epidemiological situation, set priorities, collect data on morbidity and mortality, analyse costs, and select the most appropriate mix of interventions, including chemotherapy, health education, water supply and sanitation, and snail control. Details range from a description of the complex population dynamics of schistosomes, through an explanation of the types of diagnostic and treatment services that can be provided at different levels of the health system, to advice on how to persuade those in charge of water resources and irrigation projects to incorporate health goals in their development schemes.

While noting the severe financial constraints faced in many endemic countries, the report cites recent findings and experiences that make it possible for each endemic country to take action against schistosomiasis, even when resources are scarce and health services limited. The report further concludes that, in the long term, successful implementation and maintenance of control will depend on effective community-based health services.

The second part gives specialists a detailed state-of-the-art review of all technical developments relevant to control. Separate sections describe the distinctive patterns of morbidity and mortality seen in each form of infection, update current knowledge about the parasite and its mammalian hosts, and summarize what is known about the snail intermediate host and its susceptibility to control by molluscicides, biological agents, and environmental management. Brief information on the documented links between water supply and sanitation projects and the prevalence of schistosomiasis is also provided. Other sections describe a range of advances in diagnostic tools, from hospital-based radiological investigations to the use of portable ultrasound equipment at the village level, and issue advice on treatment and retreatment schedules for chemotherapy with praziquantel, metrifonate, and oxamniquine.

The final part uses profiles of control programmes in 23 countries to document the feasibility of control and illustrate the diversity of approaches that can be applied according to different national conditions, forms and prevalence of infection, health care systems, and available resources. The report concludes with a list of indices and methods that can be used in establishing adequate baseline information in monitoring operations, and in evaluating schistosomiasis control programmes.

The Control of Schistosomiasis

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From an operational point of view, four distinct endemic areas can be considered: the Rusizi Plain, the suburban focus of Bujumbura; Imbo-Sud, border-
areas grew from 450,000 in 1985 to 520,000 in 1990. Because of steady demographic pressure, human resettlement and agricultural development were initiated recently in the eastern part of the Bugesera depression (around Lake Rwere) and the Moso Plain. Although not yet a public health problem, schistosomiasis occurs in these areas and is also likely to extend into the coming years. The number of people at risk is estimated to be 220,000.

Administratively, Burundi is divided into 15 provinces and 114 communes, each made up of several collines, which in turn are divided into sous-collines (dispersed habitation) or transversales (organized habitations, Russian Plain). The ratio of health centres to population is approximately 1:14,000 in the Rusizi Plain, 1:20,000 in suburban Bujumbura, 1:35,000 in Imbo-Sud, and 1:40,000 in Bugesera. The annual recurrent budget for health in Burundi is US$1.6 per inhabitant, not including salaries. Drugs and reagents account for 27% of this budget.

Materials and methods

Morbidity control

In the initial attack phase of the programme, selective chemotherapy was used as the strategy for morbidity control. Screening was based on examination from each inhabitant a simple 25-mg Kato smear (2). Prepared from a fresh stool sample and left to clear for 45 minutes (3), all schistosome eggs were counted; the presence of eggs of other common intestinal helminths (hookworm, Ascaris, Trichuris, and Taenia) was recorded semiquantitatively. Persons with at least one schistosome egg on a single slide were treated with a single dose of praziquantel (40 mg/kg body weight), and individuals with tapeworm infections were treated with a single dose of praziquantel (20 mg/kg body weight). This strategy was applied to all communities and age groups in rural endemic areas. Chemotherapy campaigns were carried out once in the Rusizi Plain and Bugesera. In Imbo-Sud they were repeated several times in highly endemic collines, since systematic coverage was not feasible owing to the dispersed habitat and unstable demography. In the endemic suburbs of Bujumbura the same strategy was used annually for the high-risk group of children aged 6–15 years, through a programme in primary schools.

The impact of selective chemotherapy on infection was monitored by means of annual sample surveys in the Rusizi Plain (Rugombo, Buganda and Gihanga, Fig. 1). The sample comprised every 10th household, starting with a random number, in each sous-colline or on each transversale. If the household head refused to participate, an adjacent household was included. In this manner a self-weighting 10% sample was obtained, taking into account the highly focal distribution of schistosomiasis.

Chemotherapy campaigns and surveys were carried out by two specialized mobile teams; one in the Rusizi Plain and Bugesera (6 microscopists) and the other in Bujumbura and Imbo-Sud (4 microscopists). Quality control was performed by systematic random re-examination of about an eighth of the daily number of Kato slides examined.

During the maintenance phase of the programme, the diagnostic capacity of health centres in endemic areas was improved by introducing the Kato method and well-defined clinical indications for stool examination (direct examination + Kato slide). After the initial training of microscopists in the health centres, quality control was performed once a year and refresher courses were organized if necessary.

The central mobile teams were integrated into the regional health services, and their services could be called upon to deal with particular problems.

Snail control

Snail populations were assessed using a man-minute method (4 collectors searching for 15 minutes). Niclosamide was applied using a knapsack sprayer for shallow stagnant waters (concentration of 1.5 x 10^(-6) mmol/l or 2.0 ppm) or using a constant-head applicator for flowing waters (concentration of 5.1 x 10^(-6) mmol/l or 2.0 ppm) for 6 hours.

Environmental control of transmission

In Burundi safe water is commonly supplied to lowland areas by networks of piped water, collected on the (rainy) mountain crests. Standard laundry units consist of blocks of four ventilated pit-latrines. Private latrines are promoted by selling concrete slabs at a subsidized price (ca. US$10); once the latrine is built by the owner, it is checked by a health assistant before the vent piping is supplied.

In the educational video-film was produced and is shown annually to the senior classes of all primary schools in areas of Burundi where schistosomiasis is endemic. More recently, simple information panels and posters, leaflets, and T-shirts promoting early diagnosis and prevention of schistosomiasis have been prepared for use in a more comprehensive large-scale information-education-communication (IEC) campaign.

Table 1: Sequence of control measures in the four areas of Burundi endemic for schistosomiasis, 1985–91

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<tr>
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<td>Rugombo</td>
<td>Gihanga</td>
<td>Rugombo</td>
<td>Buganda</td>
<td>Mpanaa</td>
<td>Buganda</td>
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<td>Single selective chemotherapy + monitoring</td>
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<td>Environmental control of transmission (Rusizi Plain)</td>
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<td>Single selective chemotherapy</td>
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<td>Annual selective chemotherapy of primary school children</td>
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<tr>
<td>Imbo-Sud</td>
<td>Repeated selective chemotherapy in highly endemic collines</td>
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* E = evaluation
* PHC = primary health care.
Results

From 1985 to 1990 about 160 000 people participated in the selective population chemotherapy campaigns in rural areas and about 70 000 stool examinations were performed during the school programmes in urban areas (Bujumbura, Rumonge). The campaigns in the Rusizi Plain took place between 1985 and 1989. The prevalences and intensities of schistosomal infection measured during these campaigns are summarized in Table 2. The average participation rate was 80%, and this varied from 67% to 97% in the various communes. The rate was highest in the northern part of the plain where the population was more stable. Bugeesa was covered between 1989-90. The measured prevalences and intensities of infection are summarized in Table 2. Here, the participation rates varied from 54% to 97% in the various communes, with an average of 63% for the whole area. In Imbo-Sud repeating selective chemotherapy was used from 1985 to 1990 in the highly endemic communes just north of Rumonge. The prevalences of schistosomal infection measured during these campaigns are summarized in Table 3. The total cost of the selective treatment campaigns was approximately US$ 1 per person examined over the study period. The cost of praziquantel accounted for 50% of the running costs of the campaigns.

We were able to evaluate the effect of this strategy on the passive detection of cases in general health services in the northern part of the Rusizi Plain (Rugombo). The results are shown in Fig. 2.

The evolution of the prevalence of infection after selective population chemotherapy in the three monitored communes in the Rusizi Plain is shown in Fig. 3. Two years after intervention, the prevalence had reverted to 65%, 100%, and 85% of its initial level in Rugombo, Gihanga and Buganda, respectively. The proportions of people treated, examined (but found negative), or not examined during the treatment campaigns are also shown. The proportion of infected people who were new to the area became important from the third post-intervention year onwards.

Table 2: Prevalences and intensities of schistosomal infection detected during selective population treatment campaigns in the Rusizi Plain and Bugeesa, Burundi

<table>
<thead>
<tr>
<th>Commune of area</th>
<th>Average prevalence (%)</th>
<th>Mean egg load (epg)</th>
<th>% of individuals excreting &gt;100 epg</th>
<th>% of individuals excreting &gt;400 epg</th>
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<tbody>
<tr>
<td>Rusizi Plain</td>
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<tr>
<td>Rukana</td>
<td>15 (2-26)</td>
<td>95 (40-136)</td>
<td>4 (0-9)</td>
<td>1 (0-2)</td>
</tr>
<tr>
<td>Rugombo</td>
<td>32 (6-63)</td>
<td>122 (77-190)</td>
<td>13 (1-38)</td>
<td>4 (0-16)</td>
</tr>
<tr>
<td>Buganda</td>
<td>13 (3-48)</td>
<td>114 (75-268)</td>
<td>5 (1-17)</td>
<td>2 (0-11)</td>
</tr>
<tr>
<td>Gihanga</td>
<td>20 (6-21)</td>
<td>114 (72-180)</td>
<td>7 (2-15)</td>
<td>2 (1-7)</td>
</tr>
<tr>
<td>Mulumbu</td>
<td>33 (6-83)</td>
<td>175 (86-308)</td>
<td>18 (3-38)</td>
<td>8 (1-23)</td>
</tr>
<tr>
<td>Mpanda/Buringa</td>
<td>34 (5-56)</td>
<td>189 (81-294)</td>
<td>21 (2-36)</td>
<td>9 (0-19)</td>
</tr>
<tr>
<td>Bugeesa</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Area A</td>
<td>19 (10-26)</td>
<td>133 (82-199)</td>
<td>10 (4-17)</td>
<td>3 (0-6)</td>
</tr>
<tr>
<td>Area B</td>
<td>7 (1-13)</td>
<td>82 (56-143)</td>
<td>2 (0-6)</td>
<td>0.5 (0-2)</td>
</tr>
<tr>
<td>Area C</td>
<td>4 (0-6)</td>
<td>116 (40-128)</td>
<td>2 (0-3)</td>
<td>0.5 (0-1)</td>
</tr>
</tbody>
</table>

* Figures in parentheses are the range, based on an analysis per sous-colin.

Table 3: Prevalences of schistosomal infection detected during repeated selective population treatment campaigns in various communes in Imbo-Sud, Burundi, 1985-90

<table>
<thead>
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<tr>
<td>Rukana</td>
<td>19 (11-3)</td>
<td>5 (2-0)</td>
<td>5 (1-1)</td>
<td>5 (3-9)</td>
<td>5 (3-9)</td>
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<tr>
<td>Rugombo</td>
<td>17 (8-2)</td>
<td>16 (10-4)</td>
<td>27 (15-6)</td>
<td>19 (9-4)</td>
<td>22 (12-4)</td>
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<tr>
<td>Buganda</td>
<td>33 (20-8)</td>
<td>18 (10-2)</td>
<td>22 (11-4)</td>
<td>31 (18-6)</td>
<td>18 (12-6)</td>
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<tr>
<td>Gihanga</td>
<td>22 (11-4)</td>
<td>10 (4-11)</td>
<td>21 (13-3)</td>
<td>27 (15-6)</td>
<td>23 (12-4)</td>
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The first figure in parentheses is the % of infections with >100 epg, while the second figure shows the % of infections with >400 epg

Fig. 2. Effect of selective population treatment on passive detection of schistosomiasis cases in general health services in Rukana/Rugombo (Rusizi Plain).

Fig. 3. Effect of selective population treatment on passive detection of schistosomiasis cases in general health services in Rukana/Rugombo (Rusizi Plain).
were distributed to 25% of all families in the area. The cost of this programme was USS 32 per inhabi-
tant (USS 22 for the new piped water system and
USS 10 for the additional infrastructure), representing about 2-3% of the planned investment in new
irrigation schemes in the area.
Surveillance surveys were carried out in the new
risk areas in the eastern part of Burundi. In
Nyanza-Lac (1987) a population-based survey
showed that the overall prevalence rate of schis-
itosomiasis was 6% (range per sous-colline: 2-11%),
almost identical to the prevalence in 1984. Among the
population living along the shores of Lake Rweru
(Fig. 1), 4% (range per sous-colline: 2-8%) was infect-
ated in 1989. A health-centre-based survey in the
Mosoi Plain (1989) found few cases (6 out of 1005
people examined) scattered over the area, which is
not much different from the situation in 1984 (1).

Discussion
Almost 5 years of fieldwork were required to carry
out the selective chemotherapy campaigns in all the
erdinal rural areas. Monitoring surveys showed that
communities rapidly became reinfected. In the first 2
years following the launch of the schistosomiasis
campaigns in each of the study samples
had participated in selective population treatment
campaigns, but were found to be negative upon
screening. These findings are consistent with the
conclusions of preliminary operational studies (4)
and can, at least in part, be explained by the low sen-
sitivity of the screening method for relatively light
infections. Under operational conditions this is com-
pounded by the demographic changes in the study
area. Indeed, despite the satisfactory participation
rates only 60% of the 1990 population in the rural
areas covered to date have benefited from this campa-
ign. Repeated interventions are thus necessary to
ensure continuity of morbidity control. Finan-
cial, logistic and organizational limitations are
major constraints to the long-term sustainability of
such an approach.
Therefore, an attempt was made to improve the
capacity of morbidity control using a primary health
care approach. The results have been encouraging.
At the current rate of detection of schistosomiasis in
the Rusizi Plain, approximately 10% of all cases
(detectable with a single 25 mg Kato slide) receive
treatment every year; comparison with selective
population treatment shows that only 14% of cases (16% of
cases treated yearly; demographic changes not
taken into account) showed that the annual yield of
cases detected by basic health services was 60%,
at an eighth of the cost per inhabitant. Although the
signs and symptoms of intestinal schistosomiasis are
non-specific, and mixed intestinal infections are
common, we can assume selection in favour of
symptomatic cases. An additional advantage of a
primary health care strategy is its ability to keep pace
with demographic changes. A further increase in the
demand for early diagnosis and treatment can be
expected once the IEC campaign becomes fully
operational. In some endemic areas of Burundi
(Bugesera, Imbo-Sud) the impact of this type of stra-
phe is still slight because of poor access to health
services; rapid improvement of this situation can be
expected in view of the strong commitment of nation-
al health authorities and funding agencies to increasing
primary health care coverage.

Some aspects need to be further investigated; for
example, the importance of schistosomiasis-related
hepatic morbidity in Burundi and the impact of chemotheraphy on it. Community-based surveys have
shown increased rates of (mild) hepato- and spleno-
megaly related to schistosomiasis, but few or no
cases of clinical portal hypertension (1). Health
centres detect few cases of severe hepatosplenic
disease. On the other hand, operational studies have
not found a significant reduction in liver and spleen
enlargement rates, even after repeated chemotherapy
(5). Various uncontrolled ultrasonic studies in the Gezira
region of the Sudan have reported a high frequency
of liver disease, its reduction by chemotherapy, and
the unreliability of indirect assessment of schis-
itosomiasis morbidity (6, 7). The planned use of ultra-
sonography in Burundi should clarify the situation
and reveal whether additional control action is
needed.

In view of the results of the school programme
in Bujumbura, the frequency of the selective chem-
otherapy in two of the four endemic suburbs was
reduced from 1990 onwards by restricting its use to
only the first, fourth, and sixth classes in each
school. This maintenance strategy has permitted an
two year extension of the school programme to risk areas in
Imbo-Sud, where an unstable demographic and
endemic situation, intensive intervention, and relat-
ively easy access to health services justify this extra
intervention.
Despite considerable efforts and its high costs,
the results of focal snail control have been dis-
appointing. This is largely because of poor weed
destruction and the operational difficulty of covering entire water networks, leading to rapid recolonization of treated sites by snails.

Therefore, the emphasis in snail control has shifted
to proper engineering and maintenance, directed to-
wards farmers and irrigation managers. Some oper-
ational research in the use of plant mollusci-
cides has also recently been initiated (8).
The most satisfactory outcome of the programme
has perhaps the early diagnosis that has been made in
the supply of safe water. Donor as well as national agen-
cies have been persuaded to increase the quantity of
water supplied to areas endemic for schistosomiasis.
In any case, the management of the Rusizi Plain
community standpipes is now available to all 80 000 inhabi-
tants within 500-700 m of their homes. The rest of the
Rusizi Plain and part of Imbo-Sud (Nyanza-Lac) will
benefit from community water facilities (such as shower units, laundry units and
footbridges) being provided near traditional sites
of intense man-water contact. Such facilities are
very popular when they are in good working order.
However, maintenance is still a problem and local
authorities are trying to find adequate solutions to
this difficulty; families have recently started paying
an annual tax (US 0.40 per head) for this purpose.
The private latrine programme started well. Subs-
 idized prices and credit facilities are a prerequisite
for its success, although they may hinder the pro-
grame. In the recent past, the Community Health
funds have been persuaded to increase the quantity of
water supplied in Imbo-Sud, where an unstable demographic and
economic situation and access to health services justify this extra
intervention.

In conclusion, it can be stated that the strategy
of schistosomiasis control in Burundi has evolved
counterclockwise from systematic treatment of infections to early
treatment of intestinal disease. The available health
infrastructure has allowed the control strategy to be
integrated to a high degree into basic health services.

Acknowledgements
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teams and peripheral health personnel. We also acknowl-
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sanitation in the southern part of the Rusizi Plain was
financed by the European Development Fund and the
Kreditanstalt for Weideraufbau.

Résumé
La bilharziose à Schistosoma mansoni au
Burundi: progrès de la lutte depuis 1985
La bilharziose intestinale à Schistosoma mansoni
est présente au Burundi dans les régions de
basse altitude. Un programme de lutte a été insti-
tué dans quatre de ces régions: la Plaine de la
Rusizi, la zone semi-urbaine entourant Bujumbu-
a, l’Imbo-Sud et le Bugesera. Au début de sa
mise en œuvre en 1985, ce programme de lutte
était basé sur: a) la chimiothérapie sélective,
appliquée à toute la population entourant rural
et rural (16 à 42 ans) en milieu semi-
urbain; b) la lutte ciblée contre l’hôte intermédiaire
c et d) l’amélioration des conditions d’hygiène.
L’effet favorable de la chimiothérapie sélective
(faut. 1 USS par personne) sur l’intensité et
valence et l’intensité des infestations ainsi que sur
le nombre de cas de bilharziose détectés dans les
services de santé généraux, a été montré.
Prévention des infections dans une popula-
tion changante, associée à l’effet de la sensibilité
réduite du test diagnostique (Kato 25 mg) en cas
d’infestation légère, impose la répétition régulière
de ce genre d’intervention afin d’assurer une

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continuité dans le contrôle de la morbidité. Les chances de pérennisation de cette stratégie étant jugées faibles, une approche plus intégrée a été testée. Les capacités de diagnostic précoce des services de santé de base ont été améliorées, entre autres par l’introduction de la méthode Kato. Dans les régions où l’accessibilité à ces services est bonne, on a pu ainsi multiplier par 4 le nombre de cas détectés. En d’autres termes, environ 10% des cas présumés y sont actuellement détectés et traités chaque année par cette stratégie intégrée. Par rapport aux traitements de masse sélectifs cela représente un potentiel de détection de 60% pour 1/8 du coût. La morbidité continue dans le contrôle de la morbidité. Les capacités de diagnostic précoce des tests sélectifs cela représente un potentiel de

References

Trypanosomiase humaine africaine: étude d’un score de présomption de diagnostic au Congo

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Une enquête cas-témoins a été réalisée au Congo afin de définir une grille de score de présomption de la maladie du sommeil à T.b. gambiense, basée sur une sélection de critères cliniques et épidémiologiques de la trypanosomiase, utilisables par les structures sanitaires périphériques.


L’analyse des résultats confirme qu’il n’existe pas de critère ou groupe de critères pathognomoniques. Aucun des critères sélectionnés n’est suffisamment discriminant pour permettre une sélection des trypanosomiases parmi les consultants. Une grille de score de présomption semble donc de peu d’utilité au niveau périphérique; ceci est d’autant plus vrai si l’on considère l’augmentation de la charge de travail.

Le faible pouvoir discriminant des signes cliniques et des symptômes ainsi que des autres paramètres de la trypanosomiase africaine met en évidence la difficulté de mise en place d’une stratégie d’intégration efficiente en temps qu’outil diagnostique précoce.

Introduction
L’intégration des programmes de lutte constitue l’orientation actuelle des politiques de santé. La précocité des structures d’accueil impose des critères de présomption diagnostique simples et efficaces (3, 9, 11, 12, 14).

Cette étude a cherché à définir un score de présomption épidémiologique de la trypanosomiase humaine africaine à Trypanosoma brucei gambiense (THA) à chaque stade de la maladie, afin de doter les structures sanitaires implantées dans les foyers d’un outil opérationnel et fiable de dépistage.

Compée tente de la faible prédictivité des signes cliniques et du pourcentage très élevé de malades asymptomatiques, le dépistage passif dans des centres non spécialisés ou dans des centres fixes est très tardif (15).

Une combinaison de signes cliniques et épidémiologiques peut permettre d’augmenter le pouvoir discriminant du dépistage passif (2).

Nous avons testé 16 critères lors d’une enquête cas-témoins. L’analyse statistique nous a permis d’établir des scores de présomption pour les différentes phases de la maladie. Les seuils d’efficience des différents scores devraient permettre de décrire différentes stratégies d’intégration.

Matériel et méthodes

Lieu et type d’enquête
En mai 1990, nous avons réalisé une enquête cas-témoins au cours d’une tournée de dépistage systématique de la THA dans le foyeur de Bokolongbo (province de la Bouenza, Congo).

References
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