Reviews/Analyses

Measurement of schistosomiasis-related morbidity at community level in areas of different endemicity*

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Among the indicators of schistosomiasis morbidity currently used in control programmes, ultrasound has been found to be a safe, non-invasive and efficient technique for detecting schistosomiasis-related lesions and for assessing the effect of treatment on their resolution. Three case-studies from East Africa, in areas of different endemicity for Schistosoma haematobium, *using ultrasound are described and their results related to indirect measurements of the disease (e.g., haematuria, egg counts).*

This review reveals that cross-sectional ultrasound surveys can be used to quickly assess subsamples of populations in areas of different endemicity, in order to make decisions about sampling strategies in control programmes. The association between the intensity of infection and urinary tract abnormalities is reviewed and evaluated. One case study provides information on the resolution of S. haematobium-*related uropathy after treatment; this information is crucial in order to maintain low levels of morbidity in a community. The role of ultrasound is further discussed, particularly as a tool to complement and validate indirect morbidity control measurements. The validation of such indirect measurements for use as a basis for public health decisions is important because they can be carried out by existing health care services in many areas.*

Introduction

Schistosomiasis, one of the most widespread parasitic infections affecting man, presents an important occupational risk in tropical and subtropical areas (1). The present aim of the global control strategy is to reduce schistosome-related morbidity rather than primarily to reduce transmission or even eradicate the disease. The change from transmission control to morbidity control was partly initiated by the development of safer and more effective drugs and simple diagnostic techniques (2). Numerous national and regional control strategies have been developed on the basis of experience of long-term multiple control operations (3) and the availability of local resources within primary health care (PHC) (4).

Since control operations require monitoring and evaluation strategies that are tailored to the local conditions (5, 6), the focus on morbidity control calls for careful validation of the direct and indirect indicators of schistosome-related morbidity. The availability of such indicators and knowledge about their diagnostic performance in a given endemic setting are necessary to design effective treatment and retreatment schemes to reduce morbidity and maintain low morbidity levels despite possible ongoing transmission (5).[a]

Among a number of indicators of schistosomiasis-related morbidity (5), there is widespread use of simple, indirect measurements such as egg counts and haematuria/proteinuria detection, which can be assessed by urine filtration and dipstick testing, respectively. However, the predictive potential of these indicators has hardly been evaluated from the attack phase to the maintenance phase of a control programme in situations where there is a changing prevalence of morbidity. Most frequently, egg-count categories for both stool and urine examinations have been used as a measure of disease and related to the severity of clinical findings for *Schistosoma mansoni/japonicum*, and to laboratory findings for *S. haematobium* (1). These indicators do show a strong positive correlation in most epidemiological studies, but it remains to be established whether, and to what extent, clinical examination and laboratory findings reflect the actual morbid anatomy of the disease and its functional consequences.

Until recently, the assessment of pathological lesions due to schistosomiasis required invasive and/ or sophisticated tools (7, 8). Ultrasound scanning was introduced in the 1980s as a safe, non-invasive and efficient technique to assess schistosomiasis-related lesions in man (9–11). The application of ultrasound for screening populations at community level in *S. haematobium*-endemic areas was first described by Degrémont et al. (12) and Doehring et al. (13), and detailed follow-up studies of morbidity patterns after treatment are now available (13–15).

This paper discusses schistosome-related morbidity measurements, with particular reference to ultrasound, and presents the results of three case-studies in areas where *S. haematobium* is endemic.

Morbidity indicators

The available measurements of morbidity for intestinal and urinary schistosomiasis were reviewed by Tanner (5). To evaluate the different direct and indirect measurements, a standardized assessment of each morbid condition/state is required so that the sensitivity and specificity data from different endemic settings will be comparable.

Indirect measurements of *S. haematobium* infections were recently evaluated in a district-based study in the United Republic of Tanzania. Correlations between day-to-day variation of egg excretion and reagent strip testing for haematuria and proteinuria by Lengeler[b] show that such variations in egg excretion were high and followed a negative binomial distribution. Microhaematuria gave the strongest association between prevalence rates measured by a single urine filtration and single reagent strip testing. This study also showed that microhaematuria had the lowest coefficient of variation (CV) among the different measurements (five days' testing). These data clearly demonstrated the potential of haematuria as a morbidity indicator. On the other hand, the high day-to-day variability of the egg counts leads us to question the appropriateness of using egg count limits based on single filtration results as an indirect morbidity grading.

Use of ultrasound

Assessment of morbidity and monitoring of control measures have so far relied to some extent on clinical indicators, and even more on indirect laboratory tests (1, 16, 17) rather than on assessment of pathological signs associated with the disease. Use of ultrasound scanning to detect lesions in the liver in *S. mansoni* infections (18) and in the urinary tract in *S. haematobium* infections (10) was introduced recently. Sonographic detection of lesions due to *S. japonicum* infections was described by Murakami (19) and in a WHO report.[c] Unlike invasive and/or sophisticated techniques such as endoscopy and biopsies for *S. mansoni/japonicum*, or intravenous urography, cystoscopy and computer tomography for *S. haematobium*, which all require hospital facilities, ultrasound scanning can be applied in the field to investigate affected populations in their communities (12).

The efficiency of ultrasound in detecting lesions has been demonstrated in comparison with the results of liver biopsies in *S. mansoni* infections (20) and with intravenous urography and cystoscopy in *S. haematobium* infections (11). Reports on the evolution of obstructive uropathy after treatment have recently been published (13, 21) and a follow-up of disease clearance is given in a Tanzanian study (14).

Uropathy is significantly associated with egg counts and haematuria. However, in each of the three case studies presented in this paper a substantial number of cases with uropathy in the absence of detectable eggs in the urine was noted. The following factors need to be considered in this situation:

(1) Some of the subjects may not have shed eggs at the time of the urine examination or, less likely, the eggs may have been missed. This could result from

the substantial day-to-day variation of egg output discussed above.

(2) Signs of disease can be present in the true absence of egg excretion. Eggs can be trapped in lesions, especially in long-standing infections. Just after treatment, eggs are also absent, but lesions will still be present. Irreversible lesions will obviously be detected long after infection is over.

(3) The observed pathological signs may have a cause other than schistosomiasis. Careful evaluation of the disease pattern in the area where ultrasound is applied is necessary to exclude such causes on epidemiological and clinical grounds. In areas where urinary schistosomiasis is endemic, the epidemiological importance of confounding causes of uropathy appears to be small (11). With regard to intestinal schistosomiasis, information on this point is still lacking.

The relation between ultrasound and indirect morbidity indicators needs to be established at two levels:

— at the beginning of a control programme in a given area; and
— at different stages after an intervention has taken place.

The predictive values of different indirect measurements for detecting or excluding disease are of crucial importance in large-scale control programmes. The risk of an infected person developing pathological signs before intervention is probably higher than the risk after intervention, as reinfections will take some time to produce new lesions (time factor vs infection intensity). However, long-term follow-up studies including reinfection patterns, which would clarify such issues, have not yet been reported in the literature, despite the fact that there are many on-going large-scale morbidity control programmes which are very suitable for such studies (5).[d]

A summary of diagnostic and practical features involved in the use of ultrasound scanning is given in Table 1. The capital cost of an ultrasound scanner is high, but maintenance costs of field-tested machines such as the Sonoline 1300 are very low. Our programmes used such a machine for more than four years at both hospital and community levels; it proved completely reliable and needed no special maintenance. Unfortunately this excellent scanner is no longer produced.

The groups with the highest prevalence and intensity and consequently at the highest risk of developing pathological lesions are children and

Table 1: **Assessment of ultrasound scanning for detecting and monitoring schistosomiasis-related morbidity**[a]

	Rating[b]	Assessment
Sensitivity	+ +	High; S.h. > S.m./j.
Specificity	+ +	High in endemic areas of S.h. S.m.: pipe-stem fibrosis of liver pathognomonic
Efficacy	+ +	High: direct visualization of lesions possible
Capital cost	0	High: US$ 20 000 minimum; $1500 for field generator
Recurrent cost	+ +	Low: approx. US$ 500 per year
Maintenance	0	Need for special technician/workshop
Safety	+ + +	High: non-invasive, no X-ray
Acceptability	+ +	Excellent: non-invasive, attractive to individuals
Applicability	+ + +	High: portable equipment, dark room needed
Efficiency	+ + +	High compared to invasive methods
	+ +	High compared to egg counting
	+ + +	Excellent complement to indirect indicators when established for a particular endemic setting
Area of application	+ + +	Research: ideal tool
	+ +	Monitoring of control: very valuable for well-defined samples or indicator cohorts
	+	Routine clinical medicine: useful
	0	Routine community medicine: not feasible

[a] *Schistosoma haematobium* (S.h.), *Schistosoma mansoni* (S.m.), and *Schistosoma japonicum* (S.j.).
[b] 0, +, + + and + + + are semi-quantitative ratings, explained in the adjacent column.

adolescents from 6 to 20 years of age. Therefore schoolchildren (usually between 7 and 15 years of age) are an appropriate target group for monitoring the control measures, including the application of sonography. In addition, there are several practical advantages in carrying out monitoring programmes at school level, such as:

— the educational services provide good access to the target group;
— in most areas good cooperation from the teachers can be expected;
— the follow-up is relatively easy; and
— school-age children are not afraid of an unusual examination such as ultrasound.

The use of ultrasound has thus been shown to be practicable, and its use in surveys has been shown to be feasible, especially among schoolchildren. However, the training of skilled staff to perform, read and interpret ultrasound imaging is a prerequisite for

Table 2: **Case studies on *S. haematobium* (S.h.)-related morbidity using ultrasound scanning: study areas and features of the study design**

	Study area		
	Pemba	Mauritius	Kilombero
Site	Pujini village	Port Louis, Plaine Magnien, Pamplemousses	Ifakara division
S.h. endemicity	High	Low	Moderate
Population	Children, adults	Children, adults	Children
No. of subjects	497	408	124
Mean age (years)	20	15	12
Age range (years)	2–80	3–57	7–20
Urine filtration	Nytrel (5–6 ×)	Nucleopore (1 ×)	Nucleopore (5 ×)
Haematuria test	Hemastix™	Hemastix™	Sangur™
Ultrasound scanner	←————————————— Sonoline 1300 with 3 MHz sector scanner —————————————→		
Study type	Cross-sectional	Cross-sectional	Follow-up after treatment

using this tool in schistosomiasis morbidity assessment. The staff performing ultrasound scanning must have a good knowledge of the possibilities of the technique and of human anatomy; coherence and consistency of the interpretation are also most important.

Owing to the dynamic state of ultrasound imaging, there is a risk of substantial intra- and inter-observer variation which may seriously affect the efficiency (sensitivity and specificity) and reproducibility of the technique. It is for this reason that efforts are now being made to standardize the classification of morbidity patterns for each schistosome species, with emphasis on the reading and interpretation of ultrasound scanning. This standardization, followed by appropriate training courses, should provide a basis for using ultrasound as a reliable tool for viable intra- and inter-programme comparisons.

Three case studies

Data on *S. haematobium*-related morbidity presented in this paper were collected during field surveys from 1986 to 1989 on the islands of Pemba and Mauritius and in the Kilombero District (mainland Tanzania). *S. haematobium* is endemic in all three areas and has been investigated previously (*19, 25*).[e] One area in this study was of low *S. haematobium* endemicity (Mauritius: < 10% of total population), and two were of moderate to high endemicity (Pemba: 79% of schoolchildren and Kilombero: 63% of schoolchildren). The study features are summarized in Table 2.

Following a brief clinical examination a comprehensive ultrasound examination of the urinary tract was carried out on all subjects, without prior knowledge of the laboratory results for any of them. A Siemens 3.0 MHz sector scanner (Sonoline 1300) was used, powered by a portable generator or local power supply. Each subject was examined in the supine position, the bladder wall structure being interpreted according to its surface regularity, thickness, and the presence of polyps (*11*). The thickness of the back wall was measured, and was recorded as pathological when ⩾ 5 mm.

Congestive changes in the kidneys were recorded as shown by Ellenbogen (*23*), except that fissures of both left and right kidneys were considered as normal to minimize any interpretation bias at low disease level. Pathological signs were recorded as mild congestion, moderate congestion, and severe congestion with hydronephrosis. Congestion of ureters was checked. All subjects with congestive changes were asked to empty their bladder and were re-examined to prevent a wrong interpretation of congestion due to a full bladder (*24*). Other kidney signs (blurred central echo complex) were not included in the evaluation.

Pathological signs were classified as negative when no uropathy related to *S. haematobium* could be detected and as positive when typical bladder and/or kidney lesions were found. All surveys were carried out at community level, in local schools or dispensaries, where one room was darkened for ultrasound scanning.

1. *Pemba Island: a high-prevalence area*

The study was conducted within the framework of the Pemba Schistosomiasis Control Programme,

Fig. 1. Comparison of *S. haematobium* morbidity in Pujini (Pemba, Tanzania): results from a cross-sectional survey in 1988 of 162 males and 335 females screened by sonography and urine analysis.
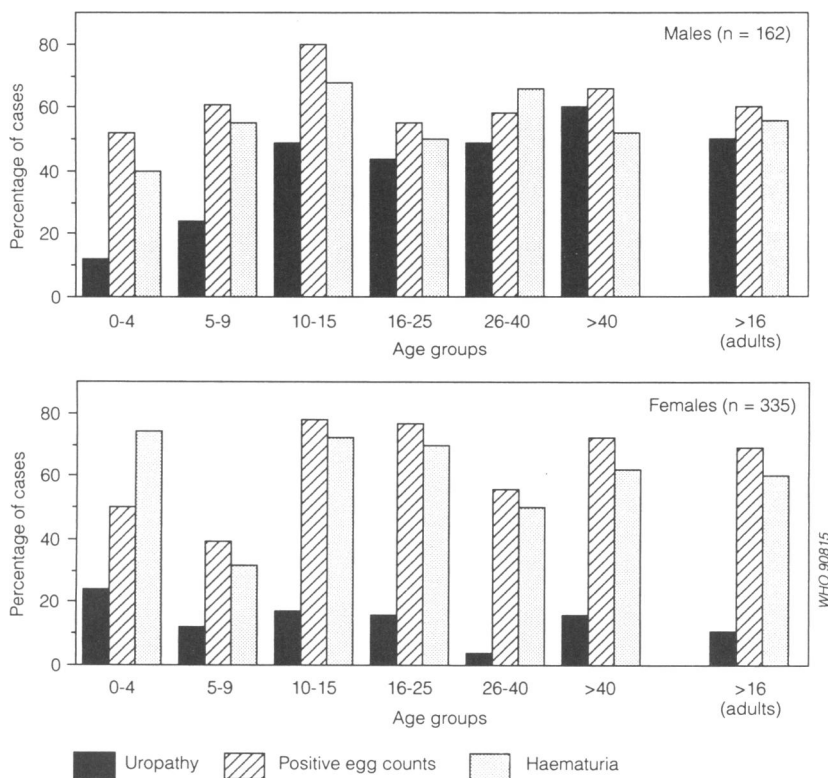
Zanzibar Ministry of Health. Cases with pathological signs, positive egg-counts, and haematuria are listed in Fig. 1, by age group, for males and females separately. The results show the pattern of *S. haematobium* morbidity measurements in a representative sample of a whole population in an endemic village, and clearly indicate the importance of validating morbidity measurements in every control programme.

The most striking feature is the comparatively low uropathy among females when compared with infection (egg counts) and haematuria rates, which could be due to the higher intensity of infection in males (data not shown). Lower exposure of the female population to infested water sites may be an underlying local factor (Savioli, personal communication), but this would not correspond to the high rates of haematuria. Menstruation, a possible confounding factor, was tested for association with egg output in this study group. As shown elsewhere,[f] menstruation

in female subjects did not appear to influence the predictive potential of microhaematuria results at community level.

The youngest children with *S. haematobium*-related uropathy were 4 years old; all three had bladder pathology (wall irregularities in two and a polyp in one), two had mild congestion of the kidneys, and two presented with macrohaematuria.

Fig. 2 compares the abnormal kidney findings, by sex and age group, based on intravenous urograms in a population in Zanzibar in 1969 (7) with our ultrasound data from Pemba in 1988. Abnormal bladder and ureter signs were excluded because comparison with the data from Zanzibar was not possible. Egg output was not significantly different in the two study groups, but the parasitological methods were different. In Zanzibar, two urine specimens were collected at 2 p.m. and the centrifuged deposit from 10 ml was used; in Pemba, five urine samples were collected between 10 a.m. and 2 p.m. and 10 ml samples were filtered using Nytrel filters. The age and sex-specific prevalence data for kidney

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[f] See footnote *b*, page 778.

Fig. 2. **Percentage of male and female cases with kidney lesions: comparison of sonography results from Pemba in 1988 with the intravenous urogram data from Zanzibar in 1969 (25).**
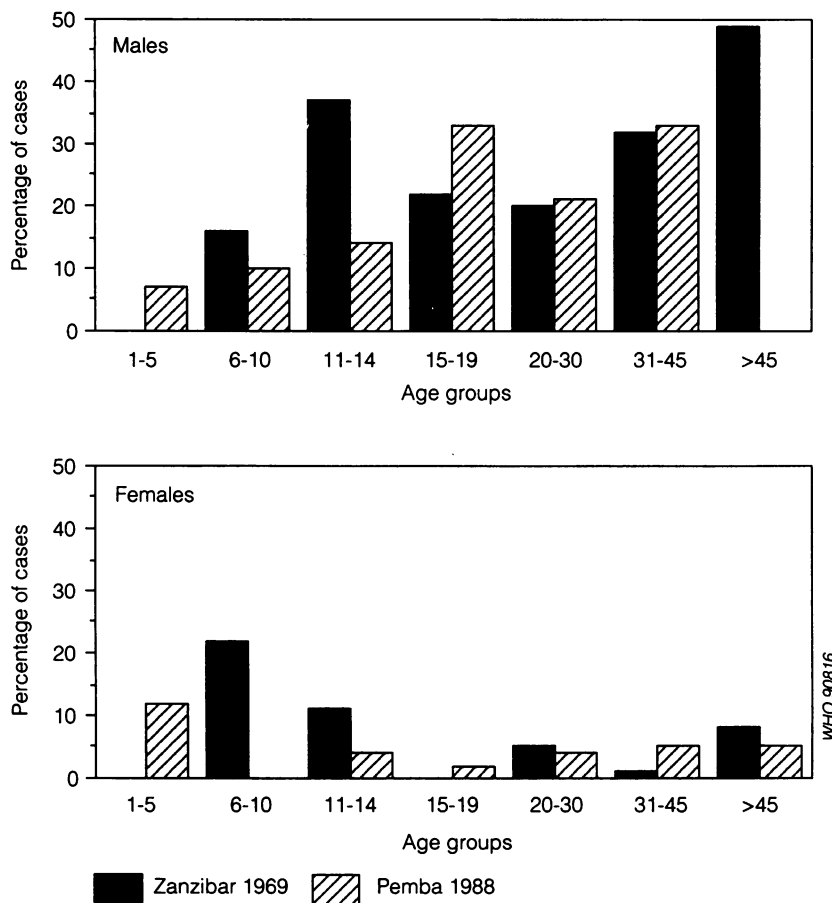
lesions are similar except for the high prevalence in males older than 45 years in Zanzibar, a difference most likely due to the low attendance of this group in Pemba ($n=8$). Data on the 6–14-year-old children may indicate that new treatment possibilities over the past 20 years may have influenced the lower rates of kidney pathological signs in Pemba. The reduction of kidney lesions in late adolescence in Zanzibar, which was related to their possible spontaneous resolution following the fall in the level of urinary egg output at this age, could not be confirmed by the Pemba data; the group of 15–19-year-old males had the highest prevalence rate recorded in the study. Although there was no treatment campaign in the study village before the survey it is conceivable that the younger age groups had been treated by the Schistosomiasis Control Team and therefore the rate of pathological signs could have reverted.

The comparison of data collected by Forsyth (25), using intravenous urograms, and by the present study, using ultrasound, to detect pathological lesions can demonstrate some of the basic advantages and disadvantages of the two techniques. Minor bladder lesions are more likely to be missed by intravenous urograms than by ultrasound. On the other hand, minor bladder calcifications are likely to be missed by ultrasound, and pathology of the ureter is far better demonstrated by intravenous urography than by ultrasound.

Ultrasound is superior in assessing kidney lesions because it provides a refined assessment of congestion and hydronephrosis by visualizing the

different textures of the kidney. Differentiation between congestion and hydronephrosis is not possible with intravenous urography to the same extent. The low resolution of lesions in Forsyth's group may have been due to a higher rate of hydronephrosis at the first examination. It is conceivable therefore that simple kidney congestion may have resolved spontaneously, or after treatment, as was shown in the follow-up study in Kilombero (14). It is obvious, however, that other factors like changing treatment strategies and disease endemicity may also have led to the differences between the results obtained with the two techniques.

2. Mauritius: a low-prevalence area

The survey was coordinated by the Schistosomiasis Unit, Ministry of Health of Mauritius. Details can be found in the study report.[g] Bladder lesions, most of them minor wall irregularities, accounted for 87% of uropathy detected by ultrasound. Congestion of kidneys without detectable bladder lesions was observed in 13% of all disease cases. Bladder and kidney abnormalities were associated together in 13%; 16 cases with either a bladder polyp and/or kidney lesion (congestion or hydronephrosis) were considered to have serious disease. The youngest cases with pathological signs were a 5-year-old boy with bladder wall irregularities and mild congestion of the right kidney and a 6-year-old girl with only bladder wall irregularities. Both cases had not been treated previously and only the girl had a positive egg count in the urine. Rates of pathological signs were higher among the older age groups. Children had mostly minor lesions in the bladder, possibly reflecting a shorter history of infection. The most severe uropathy was found in adult women, indicating a long-standing infection and/or higher transmission exposure; pathological signs probably develop slowly over years. S. haematobium infections among the younger age groups suggest that transmission still occurs in some foci in Mauritius.

A subgroup of 123 subjects (42 cases with positive egg counts and 81 controls matched for age, sex, and place of residence) was analysed; egg output, microhaematuria and anamnestic haematuria were assessed as risk factors for disease by ultrasound scanning. The results are summarized in Tables 3 and 4. A positive association was found between uropathy and egg output, which was significant in subjects older than 9 years, especially with high egg

Table 3: **Egg counts, microhaematuria, anamnestic haematuria and previous treatment to predict uropathy as assessed by ultrasound scanning**[a]

Risk factor	Number	Sensitivity (%)	Specificity (%)	Odds ratio[b]
Egg counts (5 ×):				
All subjects:	123	83	78	17.5 (5–68)[c]
5–9 years	22	50	75	
10–19 years	46	67	76	
20–39 years	55	100	81	
Microhaematuria	123	42	98	34.6 (6– > 100)
Anamnestic haematuria				
All subjects:	123	38	99	58.8 (7– > 100)
Males	60	56	98	
Females	63	27	100	
Previous treatment	123	8	96	2.1 (0.3–15)

[a] All data come from the Mauritius study where overall 87% of patients had bladder lesions.
[b] Risk associated with uropathy as assessed by sonography.
[c] Figures in parentheses are 95% confidence intervals.

Table 4: **Association of microhaematuria with egg-positive individuals (A) and with persons whose egg counts were > 50 eggs per 10 ml urine (B)**[a]

Risk factor	Number	Sensitivity (%)	Specificity (%)	Odds ratio[b]
A. Microhaematuria				
All subjects	123	26	99	28.4 (3– > 100)[c]
10–19 years	46	27	100	
20–39 years	55	33	97	
B. Microhaematuria	86	100	99	9.4 (1.9–46)

[a] All data come from the Mauritius study (see text for details).
[b] Risk associated with uropathy as assessed by sonography.
[c] Figures in parentheses are 95% confidence intervals.

outputs (⩾ 50 eggs/10 ml urine). The sensitivity of egg output for uropathy was 100% in the 20–39-year-old group. Microhaematuria and anamnestic haematuria were also positively associated with uropathy. No substantial differences between males and females were recorded. Subjects with a history of previous treatment for schistosomiasis did not have more lesions than subjects with no history of previous treatment.

The findings of this study suggest that S. haematobium-related uropathy is rarely severe in this low-prevalence area, with no foci for high-intensity transmission.

3. Kilombero: an area of moderate prevalence

A total of 72 schoolchildren were examined and followed up at one, two and six months after treat-

ment to assess disease clearance (*14*). The overall prevalence of *S. haematobium* infections was 64.9% (95% CI, 58.3–71.5%), and the overall rate of lesions was 47.5% (95% CI, 40.6–54.4%). Analysis of covariance showed a significant positive association with age, but not with sex. The laboratory follow-up investigations revealed no difference in infection, intensity, or clearance rates between boys and girls.

Initially, bladder lesions were found in 81% and congestive changes in 36% of the kidneys. Moderate to severe congestion and hydronephrosis were recorded in 3% of all kidneys. Bladder pathology was absent in three schoolchildren with moderate congestion; in one of these cases, the congestion resolved within two months after chemotherapy. Pathological signs were recorded more often in the left (52% versus 42%) than in the right kidney, but this difference was not significant. Bladder and kidney lesions were associated with egg output (χ^2, $P < 0.02$) and microhaematuria (χ^2, $P < 0.001$). Pathological changes did not differ significantly in children with heavy infections ($\geqslant 100$ eggs/10 ml urine) from those in children with light infections (< 100 eggs/10 ml). Calcifications were demonstrated in nine pupils.

The evolution of urinary tract lesions is shown in the regression curves (Fig. 3). A 90% cure rate was achieved at six months after treatment, both bladder and kidney lesions responding favourably to treatment with praziquantel. Calcifications cleared within six months. These findings are in contrast to those of previous studies (*26*) in which clearance of bladder calcifications was not observed, which was probably partly due to the particular drugs in use at the time.

Kidney congestion appeared to improve readily after resolution of the obstruction at bladder or ureter level. Even cases of severe congestion of the kidneys showed considerable improvement six months after treatment (*14*). Our findings contrast with those of King et al. (*21*) who recorded delayed clearance of kidney lesions in coastal Kenya. This difference may be due to longer-standing disease or other transmission and host particularities, bacterial superinfections, or even a different reinfection pattern. The Kilombero data from a 12-month follow-up indicate that pathological signs due to reinfection can develop within 6–12 months after treatment with the standard dose of praziquantel (40 mg/kg).

The low number of calcifications detected in the Kilombero study may reflect two facts. First, the benign nature of many lesions seen in this area could result in a lower prevalence of this complication. Second, and probably more important, it may reflect

Fig. 3. **Clearance of uropathy in the bladder and kidney after treatment with 40 mg/kg praziquantel: the lines show the exponential clearance (percentage reduction) fitted by regression analysis to the 40 mg group (based on data from Hatz et al. 1989).**
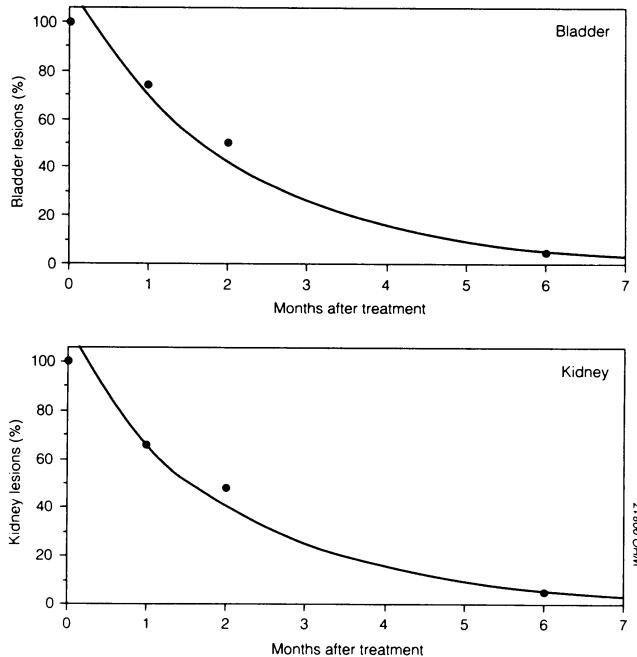
the well-known deficiency of the ultrasound technique for detecting fine lesions. Burki et al. (*11*) found an important discrepancy between positive X-ray investigations and ultrasound findings.

Conclusions

The studies summarized here show that ultrasound is a most promising tool for the direct assessment of schistosomiasis morbidity because it is safe, acceptable (non-invasive), and applicable in the field at community level. Simpler, indirect indicators will nevertheless still be needed. For example, reagent strip testing for haematuria remains a most valuable simple indicator, but the relationships between infection and indirect and direct morbidity measurements need to be further established in different endemic settings.

Surveys like the one in Pemba have provided valuable information for public health decisions. They assess cross-sectionally the status of *S. haematobium*-related morbidity in a population within a control programme prior to intervention. They reveal the sex- and age-specific pattern of pathological changes in an endemic area by confirming and validating the impression gained from indirect measurements. In this kind of situation, perhaps the greatest potential value of ultrasound lies in a quick assessment of samples or even indicator cohorts of the population covered by a control programme. Based on initial cross-sectional surveys, decisions may be made on a monitoring strategy using cluster samples or even morbidity cohorts to be followed in the maintenance phase.

The results recorded in Mauritius where *S. haematobium* endemicity is low confirmed the usefulness of ultrasound to detect uropathy, especially in adolescents and adults, and the association between the intensity of infection and urinary tract abnormalities. The data demonstrate the potential of indirect measurements (haematuria, egg output) as risk factors for uropathy, as well as the acceptable predictive value of these indicators even in low-prevalence areas. This observation will be of importance for any monitoring of control operations.

The Kilombero results provided information on the resolution of *S. haematobium*-related uropathy after treatment. This information is crucial in defining treatment and retreatment schemes in relation to maintaining the lowest possible level of morbidity in a community (*5*).[h] However, since pathological signs can disappear spontaneously (*25*), more research comparing areas with follow-up after treatment with non-intervention areas is required.

Many more studies in settings of different endemicity are needed to establish the resolution of pathological signs in relation to age (exposure) group. For example, up to which age (exposure) group can lesions, once developed, still resolve? Such information will not only determine treatment and retreatment cycles, but can also point at the target groups to be covered by the treatment cycles, thus providing the basis for more rational morbidity control strategies.

For urinary tract schistosomiasis, reliable parameters for measuring morbidity directly and indirectly have already been established, but standardization must be improved before all these indicators can be effectively used in the monitoring, evaluation and comparison within and between control programmes.

For intestinal schistosomiasis (*S. mansoni* and *S. japonicum*) indirect morbidity measures have still to be established, as there is no single indicator such as, for example, haematuria in urinary tract schistosomiasis, to predict infection. Ultrasound has, however, been shown to be a sensitive and specific tool to assess morbidity, e.g., pipe-stem fibrosis being pathognomonic of the disease. Again, standardization of methods of assessment of all these morbid conditions is an essential prerequisite for any intra- and inter-programme comparison

When the maintenance phase of ongoing control projects is considered, it is clear that standardized follow-up studies over a prolonged period of time are needed to define the predictive potential of morbidity measures in different endemic settings. The predictive potential of morbidity measurements will change in any ongoing control project, as there are likely to be substantial changes in the prevalence rates of infection and morbidity.

The relationship between pathological lesions and egg output or haematuria in an area where no previous control activities have been conducted is bound to be different from that in an area where such activities have been introduced. In the first situation we expect to see many long-standing infections, resulting in a different pattern of morbidity from the one seen in the second situation where recent infections will be predominantly present. While predictive indicators will be needed for these different epidemiological conditions as a basis for further public health decisions, we believe that ultrasound can be a valuable tool, particularly for investigating the reversion of pathological signs.

The planning and monitoring of control programmes will certainly require more long-term research on schistosomiasis; standardization of methods will help in this by making possible intra- and inter-programme comparisons. However, if the maintenance phase of a programme is to be successful, it

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[h] See footnote *a*, page 777.

is also important that morbidity control activities should be embedded in comprehensive primary health care programmes (6).

Résumé

Mesure de la morbidité due à la schistosomiase, au niveau communautaire, dans des régions d'endémicité différente

. Le but actuel de la stratégie mondiale de lutte contre la schistosomiase est de réduire la morbidité due à la maladie. La mise au point de médicaments plus sûrs et plus efficaces et de techniques diagnostiques simples fait que ce but est atteignable par des stratégies nationales et régionales de lutte. Il faut procéder à une validation et à une évaluation soigneuses des indicateurs directs et indirects de la morbidité par schistosomiase. Parmi les indicateurs actuellement utilisés dans plusieurs programmes de lutte, l'échographie se présente comme une technique sûre, non-invasive et efficace pour détecter les lésions dues à la schistosomiase et pour évaluer l'effet du traitement sur leur disparition. Des données provenant de trois études de cas, en Afrique de l'Est, sont présentées pour illustrer l'emploi de l'échographie dans des régions d'endémicité différente pour *Schisotoma haematobium.*

Une enquête effectuée à Pemba Island, Tanzanie, une région de forte endémicité, évalue par des études transversales quelle est la morbidité due à *S. haematobium* dans une population, dans un programme de lutte avant intervention, et montre un tableau de lésions pathologiques spécifiques du sexe et de l'âge. L'échographie peut être utilisée pour examiner rapidement des sous-échantillons d'une population, en vue de décider des stratégies de sondage pour les programmes de lutte.

Les résultats d'une étude effectuée à Maurice, où l'endémicité de *S. haematobium* est faible, confirment l'utilité de l'échographie pour déceler des uropathies et pour démontrer l'association qui existe entre l'intensité de l'infestation et les anomalies des voies urinaires dans de telles régions. Des résultats positifs en ce qui concerne l'excrétion d'œufs et l'hématurie se sont montrés être des facteurs de risque d'uropathie, ce qui signifie que ces mesures indirectes ont bien un potentiel prédictif dans les régions de faible prévalence.

Une étude effectuée chez des écoliers de Tanzanie, dans une région de prévalence modérée, donne des informations sur la disparition des uropathies liées à *S. haematobium,* après traitement. De telles informations sont extrêmement importantes pour établir des schémas de traitement et de reprise du traitement, de façon à maintenir la morbidité au niveau le plus bas possible dans une communauté. Il est nécessaire d'effectuer plus d'études sur la disparition des lésions dans différents groupes d'âge (exposition). Ces informations seront indispensables pour déterminer quels groupes cibles doivent être couverts par des cycles thérapeutiques. Dans la schistosomiase intestinale (*S. mansoni* et *S. japonicum*), il reste à élaborer des mesures indirectes de la morbidité, car il n'y a pas d'indicateur unique, comparable à l'hématurie dans la schistosomiase des voies urinaires, pour prévoir l'infection. Cependant, l'échographie s'est révélée un moyen sensible et spécifique d'évaluation de la morbidité.

La discussion montre quel est le rôle de l'échographie, en particulier comme moyen de compléter et de valider les mesures indirectes de contrôle de la morbidité qui sont déjà effectuées par les services de soins de santé existants dans de nombreuses régions. Des études de suivi normalisées de longue durée sont nécessaires pour établir le potentiel prédictif des différentes mesures de morbidité dans des programmes de lutte de grande envergure dans différentes conditions d'endémicité, de façon à disposer d'une base de décisions concernant la santé publique.

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