Prevalence of schistosomiasis lesions detected by ultrasonography in children in Molodo, Mali

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SUMMARY

Aim — To study schistosomiasis infection in school children in Molodo, an irrigated rice growing region of Mali, by determining the prevalence of schistosomiasis and lesions identified by ultrasonography among children living in this region.

Methods — This cross sectional study included 346 children aged 7 to 14 years selected at random from five schools in Molodo. We tested for hematuria using urine dipsticks and searched for Schistosoma haematobium eggs in urine and S. mansoni eggs in stools. Ultrasonography of the liver, spleen and urinary tract was performed.

Results — The prevalences of Schistosoma haematobium and S. mansoni infection were 72% (range: 66.9-76.6%) and 68.2% (range: 60.9-71.2%) respectively; 55.1% of the children had co-infection. Ultrasonography of the urinary tract revealed an irregular bladder wall as the most frequent abnormality (3.4% of children). Abdominal ultrasonography demonstrated type B hepatic fibrosis in four children (1.1%), type C in one (0.3%) and type D in one (0.3%).

Conclusion — Few schistosomiasis lesions were detected by ultrasonography compared with the prevalence of S. haematobium and S. mansoni infections. This observation is probably related to mass treatment programs conducted during a national anti-schistosomiasis program.

Introduction

In Mali, schistosomiasis is the second leading parasitic disease after malaria. Approximately 2.5 million persons have urinary tract schistosomiasis [1]. The prevalence is high, estimated at 55.2% for urogenital schistosomiasis [1] and more than 20% for the intestinal form [2]. The Office du Niger is an irrigated zone of rice culture which harbors two main Schistosoma species, S. haematobium and S. mansoni. Fecal matter is the primary source of transmission. Infested rivers, stagnant pools, lakes and irrigation canals harbor snails, which are the intermediate hosts and source of human infection. Schistosomiasis can have serious consequences which include: urinary tract strictures or calcification, sterility, portal hypertension, bladder cancer and hepatoportal fibrosis. To date, most of the schistosomiasis lesions observed in children by the research teams from the National Institute of Public Health have been found in the urinary tract (kidney, ureter, bladder). We wanted to determine the prevalence of intestinal and urinary tract schistosomiasis in school children in Molodo, and to describe ultrasonographic lesions secondary to S. haematobium and S. mansoni.

Patients and methods

Study design

Molodo is a rural village in Mali situated in the Segou region of the Sudanese zone, 350 km north of Bamako. The region has a three-month...
rainy season from July to September (annual rainfall 500-600 mm). The village population (3,328 inhabitants according to the 1996 administrative census) is sedentary and irrigated rice growing is the principal economic activity. An extensive irrigation system in Molodo exposes the population to numerous points of contact with water. Children attend a fundamental (public) school, a community school, and three koranic schools. Local health facilities include a Community Health Center which dispenses essential drugs and a private medical practice with its own drug dispensary. Several anti-schistosomiasis campaigns have been conducted in this area by health teams, in particular a national anti-schistosomiasis program and mass treatment with praziquantel conducted by the Niono district health center. Our cross sectional study was conducted from April 17 to 23, 2001.

**Study population**

The study population was recruited from the five schools. Using the list of children provided by the school principals, we selected a random sample of children proportional to enrollment in each of the five schools.

**Data collection**

Urine dipsticks (Haemastix) were used to search for microscopic haematuria. A 20-ML urine sample was filtered on Whatman paper to search for S. haematobium eggs. The Kato-Katz technique was used to search for S. masoni eggs in stools. Two slides were examined for each stool sample. Less than 100 eggs per gram fecal matter was defined as low-level excretion and more than 100 eggs per gram fecal matter as high-level excretion. An Aloka SSD 500 ultrasonograph (3.5 and 5 mHz heads) was used to search for schistosomiasis lesions. The ultrasonography was performed in the supine position with a full bladder. The children were asked to drink diluted fruit juice before the examination to ensure a full bladder. The following organs were explored: kidney, ureter, bladder, liver and spleen. If the urinary cavities were dilated, a post-miction ultrasonography was also performed. Urine volume was assessed before and after miction to search for significant residual volume (defined as ≤ 10% of pre-miction volume). One experienced operator performed all ultrasonographic examinations. The Niamey protocol [3] validated by the WHO was used to determine the stage of periportal fibrosis (table I). The study was approved by the ethics committee of the Bamako Faculty of Medicine, Pharmacy and Odontostomatology. Administrative authorizations and community and parental consent were obtained. The study protocol and its purpose were explained to the children by groups then individually at the different test stations. All children attending the five schools were treated with praziquantel (single dose 40 mg/kg) was thus instituted at the end of the study.

**Statistical analysis**

Minimal sample size was determined from the formula: \( N = \frac{1}{i^2} \cdot \frac{(1-\pi)}{\pi^2} \) where \( \pi = 0.70 \) (prevalence of S haematobium in the neighboring town of Niono in 2000); \( i = 0.05 \); accuracy \( \pi = 0.05 \). We increased the sample size by 10% to compensate for possible drop-outs. The sample size was thus set at 350 children.

Table I. – Classification of fibrosis using WHO Niamey protocol.

<table>
<thead>
<tr>
<th>Classification</th>
<th>Results</th>
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<tbody>
<tr>
<td>Stage A</td>
<td>No fibrosis</td>
</tr>
<tr>
<td>Stage B</td>
<td>Moderate wall thickening of at least two branches of the portal vein with moderate changes in the main portal vein and diffuse fine linear echogenicity scattered over the surface of the liver.</td>
</tr>
<tr>
<td>Stage C</td>
<td>Moderate wall thickening of at least two branches of the portal vein mainly peripherally with little or no thickening of the main portal vein and moderate stricture of the portal-vein branches. Thickening of the gallbladder walls.</td>
</tr>
<tr>
<td>Stage D</td>
<td>Moderate to severe thickening of most of the portal vein branches with marked stricture. The thickening is irregular and marked at the portal vein bifurcation (thickness 2-10 mm).</td>
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</table>

**Results**

The study population included 192 boys (54.9%) and 158 girls (45.1%). 56.9% of the children (199/350) were aged 7 to 10 years.

**Clinical data**

Hematuria was the most frequent sign, observed in 25.4% of the children. Hematuria was identified by questioning the children and examining urine samples. Pollakiuria was noted in 19.8% of children. Among the physical signs, splenomegaly was found in 74.8% and conjunctive tissue pallor in 25.2%. Stage 2 splenomegaly (Hackett classification) was the most frequent (43.6%).

**Parasite data**

Urinary schistosomiasis was noted in 72% of children and intestinal schistosomiasis in 68.2%. The prevalences of Schistosoma haematobium and S. mansoni infection were 72% (95%CI 66.9-76.6%) and 68.2% (95%CI 60.9-71.2%), respectively. 24.6% of the children exhibited high-level excretion of S. haematobium eggs and 35.1% high-level excretion of S. mansoni eggs. Macrohematuria was identified in 12/291 children (4.1%). However, dipstick tests revealed microhematuria in 53.7% of children. Mass treatment with a single dose of praziquantel (40 mg/kg) was thus instituted at the end of the study.

**Ultrasoundographic data**

The bladder presented a rectangular shape in all children. An irregular bladder wall was observed in 3.5% and a thick wall in 2.3% (table II). Bladder masses and pseudo-polyps were exceptional, found in 2.3% and 0.9% of the children, respectively (table III). Bladder masses were more frequent in children aged 11-14 years (P = 0.012) (table III). Polyps were rarely observed. Irregular bladder walls and bladder masses were more frequent in boys (75% and 62.5%, respectively). The same was true for pseudo-polyps (66.6%). Presence of post-miction residue was not related to the presence of a bladder mass. However, all children with bladder masses presented hematuria. Pyelocaliectasis was moderate and noted in 54.5% of the children in the 11-14 age group.

Splenomegaly was observed in 9.5% of the children examined. The right liver was measured in front of the right kidney and the left liver in front of the inferior vena cava. The right lobe was enlarged in 97.4% of children and the left lobe in 98.7%. Periportal thickening was observed in 0.7%. Fibrosis was noted in 1.7% (table IV). The portal vein was dilated (diameter 2-12 mm) in three children (0.9%). All cases of fibrosis (2.3%)

Table II. – Frequency distribution of bladder abnormalities.

<table>
<thead>
<tr>
<th>Irregular bladder walls</th>
<th>Number of children (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Absent</td>
<td>334 (96.6)</td>
</tr>
<tr>
<td>Focale</td>
<td>10 (2.9)</td>
</tr>
<tr>
<td>Multifocal/diffuse</td>
<td>2 (0.6)</td>
</tr>
<tr>
<td>Total</td>
<td>346 (100)</td>
</tr>
</tbody>
</table>
were observed in children with high-level egg excretion \((P < 10^{-4})\) (table V). Ultrasonographic images of fibrosis are presented in figures 1 and 2.

**Discussion**

Our work demonstrated a high rate of splenomegaly in a zone of endemic schistosomiasis and malaria. A study of thick blood smears, stains and schistosoma egg load in children is currently being conducted in other areas of Mali: Sélingué (dam reservoir) and Koulikoro (Niger river). We have no explanation for the discordance between the high rate of splenomegaly noted clinically (74.8%) and the low rate observed at ultrasonography (10%).

Among the school children who participated in this study, 72% had urogenital schistosomiasis. This is higher than the 50% observed by Dabo et al. [4] in Magnambougou, an urban community near Bamako. The prevalence of intestinal schistosomiasis was 68.2%, a rate close to that reported in N’Diol Maur Senegal in 1998 (58%), but much higher than observed in the village of N’Dioungue (29%) [5]. Rates of co-infection \((S.\ mansoni/\ S.\ haematobium)\) was 55.1%. This is the highest level reported for an ecological zone in Mali [6].

An irregular bladder wall was the most frequent lesion observed at ultrasonography (2.9% with thicken walls), 2.3% had bladder masses, and 0.9% had bladder polyps. These rates are lower than reported by Kéita et al. [6] who found bladder wall thickening, masses and polyps in 26.6%, 30.7% and 11.6% of cases, respectively. The presence of post-miction residue was observed in 6.2% of the children in this series. Kéita et al. [6] and Kané et al. [7] did not provide data on this element. The presence of residual urine is explained by incomplete miction related to a mass in the bladder (tumor or pseudopolyp).

Periportal fibrosis was observed in a few children: stage B (1.1%), stage C (0.3%), and stage D (0.3%). These lesions were found in children who excreted large numbers of \(S.\ mansoni\) eggs. Clinical signs of portal hypertension were not observed and at ultrasonography the portal trunk was dilated greater than 12 mm in only three children. In Sudan, fibrosis is almost exclusively stage C and D [8]. These rates are lower than reported by...
Lamotte et al. [9] who found 60.8% fibrosis (45.5% stage B) in children living in the Ivory Coast. These differences can be explained in part by the small number of children with a high level of egg excretion (less than 50% in both studies), by the periodic treatments with praziquantel during visits by health care teams, or other factors which have not been studied, including S. mansoni/S. haematobium co-infection and the immune status of the infected children. In Brazil, Giovani et al. [10] found a prevalence of 73% for stage B periportal fibrosis and 75% for stage C. Richter et al. [11] reported that 100% of their patients with S. mansoni hepatosplenic infection (27 from Brazil and 32 from Sudan) had periportal fibrosis. Inversely, Fattaar et al. [12] reported only 0.28% stage B fibrosis in their patients living in Egypt.

Despite the high prevalence of infection, morbidity was low. This observation was also made by Lanuit et al. [13] in the Richard Tool region of Senegal and by Alfidja et al. [14]. The explanation is the young age of the subjects since visceral complications become apparent only after several years of infection. The different anti-schistosomiasis campaigns (national program, district health center) and the introduction of mass treatment with praziquantel have reduced the rate of complications. Ultrasonography demonstrated the infraclinical nature of visceral lesions and can be used to follow lesion progression. Since visceral lesions, particularly hepatoporal lesions, are exception in children aged less than 10 years, the target population for ultrasonography would be above this age.

Cases of hepatic fibrosis regression after praziquantel treatment have been reported [15, 16]. In endemic zones, severe hepatic fibrosis can be prevented by prescribing chemotherapy twice during childhood then again as needed [16]. A complementary approach, e.g. vaccination, should be associated with anti-schistosomiasis chemotherapy [17]. The goal of anti-schistosomiasis vaccination is to prevent infection or to reduce parasite fertility, but remains a subject of debate. New immune targets should be useful for developing improved vaccines [17].

**Conclusion**

Urogenital and intestinal schistosomiasis is a serious public health problem in Mali, particularly in Molodo and other rural communities in the Office du Niger irrigation zone, the Dogon Plateau, and the Senegal river basin. Ultrasonography has considerably contributed to the search for visceral lesions involving the liver, the spleen and the urinary tract. In general, few lesions are identified at ultrasonography in comparison with the prevalence of parasite infections in this area of Mali. This would be a consequence of the different mass treatment campaigns conducted by the national public health institute which has an anti-schistosomiasis research team. A study of the immunological implications of S. mansoni/S. haematobium co-infection would be useful to determine the reason for the low rates of periportal fibrosis observed in children in Molodo.

**REFERENCES**