Schistosomiasis mansoni – Clinical features

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ABSTRACT
In the present review, we will discuss the Schistosoma mansoni form, which is the most widely distributed schistosome in humans and is found both in the Old and New Worlds. The main features of the natural history of mansonic schistosomiasis are reviewed, with emphasis on the clinical forms of the disease, their diagnosis and treatment.


INTRODUCTION
The human schistosomes or blood flukes are digenetic trematodes belonging to the Schistosomatidea superfam-

ily. The main species responsible for the clinical forms are Schistosoma mansoni, S. hematobium and S. japoni-
cum. Other species that affect humans (S. mekongi and S. intercalatum) have limited geographic distribution in Asia and Africa, respectively.

In the present review, we will discuss the S. mansoni form, which is the most widely distributed schistosome in humans and is found both in the Old and New Worlds.

Mansonian schistosomiasis is endemic in northeast Brazil, where it affects approximately 2.5 million people. The decrease in the number of infected individuals in the last few decades and the geographic frontiers of schistosomiasis remain to be established in Brazil. The main reasons for this lack of epidemiological data are the presence of the snail Biomphalaria sp., which is susceptible to S. mansoni infection in nonendemic areas, and migration.

Nowadays, in some areas such as the Caribbean Islands, Venezuela and Suriname, the prevalence of S. mansoni is very low (under 1%). Some authors believe that this might be due, at least partly, to the predatory action of some snails (e.g. Thiara granifera) or the Biomphalaria glabrata*. Such measures may be feasible in small areas, but not in our country where the Biomphalaria snails live in vast territories. In Brazil, an extensive S. mansoni control program based on treatment with oxamniquine and snail control resulted in a sharp decrease in hepatosplenic and other advanced forms of schistosomiasis.

The basic life cycle of the parasite alternates between generations, with a sexual stage of adult schistosomes in the definitive vertebrate host (man) and an asexual stage in a molluscan host (Biomphalaria). A relatively short-lived and free-swimming stage, the miracidium, hatches from the egg found in human stool and infects the snail intermediate host, where it gives rise to sporocysts that produce numerous free-swimming cercariae. These are infective both to man and to other vertebrate hosts. After skin penetration the cercariae are known as schistosomula, which migrate to the lungs and then to the liver. After maturation, both the male and female worms migrate to the terminal branches of the mesenteric veins where each female produces 100-300 eggs per day. A considerable number of eggs pass into the lumen of the bowel and are discharged into the feces. Some of these eggs become trapped in the intestinal wall and the remaining eggs are carried by the portal blood to the liver. Schistosomiasis is considered to be a «man-made disease» since humans are both the victims and the source of infection. Insanitary habits among humans such as defeca-
tion in canal water and at the same time exposing themselves to this polluted water by bathing, swimming for re-
creation, washing utensils and clothes and other forms of contact characterize endemic areas. Exposure to infec-
tion starts as early as at 6 months of age and maximal in-
fec tion and severity occur in early childhood (10-14 ye-
ars) followed by a progressive decrease. The lower prevalence in adults may be explained by lower exposure to contaminated water and to the development of acquired concomitant immunity.

Environmental changes that result from the development of water resources and population growth and migration...
can facilitate the spread of schistosomiasis. For example, the construction of the Diama Dam led to the introduction of \( S. \) mansoni into Mauritania and Senegal.

**CLINICAL FORMS AND PATHOGENESIS**

Liver disease in schistosomiasis results from the entrapment of eggs that are not excreted but instead lodge in portal venules that match the egg’s smallest diameter, about 50 µm. Eggs in the liver remain viable for about 3 weeks and secrete products that elicit a characteristic initial response, the schistosome egg granuloma. In some persons with heavy infections, the final result of hepatic schistosomiasis is severe portal fibrosis (figs. 1 and 2). Advanced schistosomal hepatic fibrosis gives a gross appearance of greatly enlarged fibrotic portal tracts, described by Symmers in 1904 as resembling clay pipets thrust through the liver, and now termed Symmers’ pipestem fibrosis. Schistosome infection can be divided into distinct stages. The prepatent stage begins with cercarial invasion and ends with initiation of egg laying. The patent stage coincides with schistosome egg production and can be further divided into acute and chronic schistosomiasis.

**Acute form (Katayama fever)**

Acute schistosomiasis is due to a fresh infection. Clinical manifestations may be absent, particularly in individuals living in an endemic area. Occasionally some individuals may develop the syndrome after an initial contact with water contaminated by \( S. \) mansoni cercariae. The most common manifestations are fever, chills, weakness, headache, anorexia, nausea, vomiting, and general malaise. Severe watery diarrhea, sometimes bloody stools, nonproductive cough, and rapid weight loss may develop. Occasionally, patients with acute schistosomiasis mansoni have been diagnosed as having typhoid fever, hepatitis, pancreatitis, miliary tuberculosis, myelitis and appendicitis, only to be cured when the schistosomiasis has been discovered after a long search. On the other hand, many patients have been erroneously diagnosed with schistosomiasis in endemic areas where this disease is common. Hepatomegaly is virtually a constant finding and is frequently accompanied by slight right upper quadrant tenderness. Transitory generalized lymphadenopathy and splenomegaly frequently appear but there is no clinical evidence of jaundice. Laboratory examinations show leukocytosis with eosinophilia, which can reach 70% and evidence of jaundice. Laboratory examinations show leukocytosis with eosinophilia, which can reach 70% and evidence of jaundice. Laboratory examinations show leukocytosis with eosinophilia, which can reach 70% and evidence of jaundice.

**Chronic forms**

The life cycle of the parasite in the host, which begins with penetration of cercariae into the skin and ends with the adult worms lodging in the terminal branches of the portal vein, explains why \( S. \) mansoni can damage several organs other than the intestines and liver. However these localizations are by far the most frequent.

**Intestinal and hepatointestinal forms**

Intestinal manifestations such as diarrhea and colicky pain are occasionally observed, but asymptomatic forms are more common.

A modulation of the egg granuloma is observed during the transition of the acute form to the chronic form: the exudative-necrotic granuloma of the acute phase becomes smaller and with fewer inflammatory cells and, consequently, it becomes less pathogenic to the liver cells. Some authors believe that in patients with poor modula-

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**Fig. 1.** Symmers’ periportal fibrosis of the liver with Schistosoma mansoni showing an egg at the center of a granuloma (detail).

**Fig. 2.** Sonographic features of periportal fibrosis in schistosomiasis mansoni.
tion of the granuloma, the disease tends to evolve to the hepatosplenic form.

Because the intestinal form is frequently asymptomatic, the diagnosis is based on the finding of *S. mansoni* eggs in stools. Schistosomotic intestinal polyposis is uncommon in Brazil but is frequently observed in Egypt.

The subdivision into an intestinal form and a hepatointestinal form is not uniformly accepted, but enlargement of the liver, mainly of the left lobe, may be seen in schistosomotic individuals living in highly endemic areas, and characterizes the hepatointestinal form. Recently, our group has reported portal and splenic overflow in both the hepatointestinal and hepatosplenic forms of schistosomiasis.

Hepatosplenic form and portal hypertension

Pathogenesis. The pathogenesis of the distinct stages of schistosomiasis and of its clinical manifestations is not well understood. Many authors agree that the egg granuloma is the main process causing tissue damage in organs such as liver, intestines, lung and pancreas. However, immune complexes derived from parasite antigens are responsible for special lesions such as glomerulopathy.

Hepatic granulomas are initiated endovascularly and are presinusoidal, mostly at inlet venules or terminal portal venules. Following initial endothelial proliferation, the blood vessels rapidly become occluded with eventual obliteration of the lumen and displacement of hepatocytes by the developing granuloma. Symmers' fibrosis of the liver, which may result in portal hypertension and congestive splenomegaly, occurs in individuals aged 6 to 20 years or 5-15 years after the onset of infection. It is the most severe form and the most common cause of morbidity and death. However, in heavily infected young patients there is a noncongestive phase of the disease with splenomegaly but without evident signs of portal hypertension. Data from Brazil show that in such cases, the spleen may become impalpable after adequate chemotherapy.

Fig. 3. «Dead worm pneumonitis» after chemotherapy in a patient with heavy infection.

A strong correlation between the hepatosplenic form and worm load in young patients has repeatedly been shown. Furthermore, experimental studies suggest that massive infections during early periods of exposure to cercariae may be important. Failure of immunologic modulation of inflammatory reactions seems to play a role. These and other factors (see below) explain the presence of hepatosplenic schistosomiasis in only a small percentage of patients with heavy worm burden.

Hepatic periportal fibrosis is caused by the T cell-dependent granuloma that develops around schistosome eggs. Experimental models of infection have shown that granuloma and fibrosis are highly regulated by cytokines. However, why advanced periportal fibrosis occurs only in certain individuals is unknown. A study performed in 75 patients with no or mild fibrosis and in 24 patients with advanced fibrosis suggested that interferon (IFN)-gamma plays a key role in the protection of *S. mansoni*-infected patients against periportal fibrosis, whereas TNF-alpha may aggravate the disease.

In some patients with heavy infection chemotherapy may produce a peculiar type of pulmonary lesion, «dead worm pneumonitis» (fig. 3), which has been attributed to a hyperergic pulmonary reaction to the products of dead worms.

The pathogenesis and pathophysiology of the hepatosplenic and other forms of *S. mansoni* infection are presented in figure 4. It is now well established that some experimental models can reproduce a «pipe-stem» fibrosis. According to Anrade, a peculiar pattern of vascular intrahepatic lesions, described later, seems to depend on 2 mechanisms: egg embolization, with a partial blocking of the portal vascular lumen, and the appearance of small portal collaterals along the intrahepatic portal system. The continuous lodging of newly arrived eggs into these thin and anastomosing blood vessels leads to vascular obstruction and periportal fibrosis.

In more advanced cases, a thin septal fibrosis, which dissected the parenchyma in several directions, is observed. Its pathogenesis is not well established. The distribution of schistosomal antigen immunoglobulins and complement C3 was studied by our group using biopsy specimens of human liver from 21 patients with hepatosplenic schistosomiasis. The kinetics of the granuloma formation and IgG deposits along the sinusoidal wall were described.

The irreversibility of schistosomotic fibrosis has been seriously disputed. Experimentally, chemotherapy markedly decreases mortality in infected mice soon after treatment. Later, periportal fibrosis can undergo degradation in a way similar to that of periovular granulomas.

In a study based on family heredograms, Tavares-Neto and Prata found a highly significant concentration of hepatosplenic forms among children from the same nuclear family, particularly when the mother was affected by the same clinical form of the disease. Furthermore, this clinical form is more frequent in whites than in blacks, even though Brazilian whites are more socially and economically advantaged. All these findings would point to a genetic component, which is not yet well characterized.
– Association of schistosomiasis with viral hepatitis B and hepatitis C. In the last few decades, several authors have pointed out the role played by hepatitis B virus infection in increasing morbidity due to schistosomiasis\(^2\). It is generally accepted that *S. mansoni* infection alone does not lead to cirrhosis\(^2\). Liver biopsy studies have shown a significant increase in chronic hepatitis and hepatic decompensation in schistosomotic patients with hepatitis B virus infection. According to Strauss\(^3\), the higher frequency of hepatitis B virus markers in the hepatosplenic form than in the hepatointestinal form is due to therapeutic measures in patients who seek medical care. This point of view is advocated by some authors\(^4\), but not by others\(^5\).

Seventeen cases of acute hepatitis C in previously infected patients with mansanion schistosomiasis were compared with 15 non-schistosomotic control patients, also with acute hepatitis C. Spontaneous viral elimination was observed in 5 controls, but in none of the patients with schistosomiasis\(^6\). Furthermore, structural liver changes were more severe in patients with double infection and hepatitis C. Some intrahepatic angiographic changes were highly suggestive of hepatosplenic schistosomiasis\(^7\).

– Hemodynamic features. Some intrahepatic angiographic changes are highly suggestive of hepatosplenic schistosomiasis\(^8\).

1. Hepatic veins. Hepatic veins are enlarged and there is a marked reduction of branching, along with a somewhat pronounced arching of large branches\(^9\). In 50 patients studied by Mies et al.\(^10\) the gradient between hepatic vein wedged and free pressures was at the upper limit of normality (7 ± 4.4 cm H\(_2\)O). In about 40% of patients, however, it was slightly raised: the gradient ranged from 8 to 17.5 cm H\(_2\)O. These findings were in agreement with those reported by Coutinho\(^11\).

2. Intrahepatic pattern of the portal system. Contrast material injected into the portal system shows an intrahepatic pattern characterized by gross amputations of large branches and by the appearance of an intense network of small-caliber vessels around portal branches. These features were described by Bogliolo in 1957\(^12\) and are known as «Bogliolo’s sign» (fig. 5).

3. Extrahepatic portal system and portal pressure. Enlargement of splenic and portal veins is usually present. Portal pressure is raised to levels similar to those seen in liver cirrhosis. In an analysis of 20 scientific papers with 432 patients in whom portal pressure was measured by various methods, usually by intrasplenic puncture, Carneiro\(^13\) found an average pressure of 33 cm H\(_2\)O.

4. Hepatic artery. Angiographic studies have shown a reduced diameter of the hepatic artery, with thin, arched branches outlining vascular gaps (fig. 6). The tortuous aspect characteristic of liver cirrhosis is not observed\(^14\). Interestingly, increased hepatic arterial flow was demonstrated in infected hamster\(^15\). These findings suggest that the poor intrahepatic arterial vasculatrization demonstrated by selective arteriography in human hepatosplenic schistosomiasis is due to «functional deviation» of arterial blood to the splenic territory\(^16\). In advanced schistosomiasis, hypertrophy of the hepatic artery may be found\(^17\).

5. Liver blood flow. Total liver blood flow, measured by various methods, is normal\(^18,19\), suggesting that increased

**Fig. 4. Pathogenesis and pathophysiology of human hepatosplenic (HS) schistosomiasis (G.I.: gastrointestinal; Ab: antibodies).**

![Pathogenesis and pathophysiology of human hepatosplenic (HS) schistosomiasis](image-url)
portal blood flow is accompanied by a reduction of arterial blood flow and that there is an interaction between portal and arterial blood flow. As already shown, the diameter of the common hepatic artery increases after occlusion of the splenic artery by a balloon catheter or after splenectomy or selective portal decompression. Some dynamic studies have demonstrated that high splenic blood flow may be responsible for the increased portal blood flow. The splenic component and the abundant network around portal branches («Bogliolo’s sign») may predominate (hyperflow component) over the obstruction of the intrahepatic portal branches produced by parasitosis (presinusoidal block), at least in cases of severe splenomegaly. However, ultrasound studies show that intense perportal thickening of the liver can be found in some patients without a palpable spleen, despite the presence of portal hypertension, probably as a consequence of spontaneous shunts. Furthermore, schistosomal portal hypertensive patients present with high cardiac index and low systemic vascular resistance compatible with a systemic hyperdynamic circulatory status similar to that of cirrhosis.

Clinical and laboratory changes. Hepatosplenic schistosomiasis can be clinically divided into compensated and decompensated forms. The latter is characterized mainly by muscular wasting, low serum albumin, and occasional, chronic ascites. However, other causes, such as alcoholism, and hepatitis B and C virus infection, are frequently responsible for the decompensated form (fig. 4).

S. mansoni shows a wide range of clinical manifestations, varying from asymptomatic to highly symptomatic forms. Sometimes the disease is accidentally discovered, either by a routine stool examination of by findings of an enlarged liver or spleen on physical examination. The main symptoms of the hepatosplenic form are related to splenomegaly and hemorrhage. Spontaneous ascites is uncommon and usually appears after an episode of bleeding or infection or in association with other liver lesions. Spontaneously appearing neuropsychiatric symptoms are very rare in hepatosplenic schistosomiasis, even with abundant collateral circulation. This syndrome is only seen after precipitating factors, mainly hemorrhage or infection.

In patients with compensated hepatosplenic schistosomiasis, arterial blood ammonia determination shows normal or slightly increased levels after hemorrhage or after an oral ammonium chloride load. This contrasts with the significant elevation of ammonia in compensated forms after portocaval anastomosis and in decompensated forms. Anemia with delayed somatic and sexual development may be observed in young people. Spider nevi, gynecomastia, and palmar erythema are rare in uncomplicated schistosomiasis.

A hard, enlarged liver with a predominant increase of the left lobe is frequently palpable. The spleen is enlarged, and Symmers’ fibrosis is one of the main causes of huge spleens in Brazil. Leukopenia and thrombocytopenia are found in most cases of hepatosplenic schistosomiasis. Anemia is common but is also due to other mechanisms, such as malnutrition, ankylostomiasis, chronic bleeding, and hemolysis.

In hepatosplenic schistosomiasis, the clotting defects are due to an impaired rate of protein synthesis by the liver or localized consumption coagulopathy, or both. The relative role of these 2 factors is not well established. Some changes in plasma coagulation systems may be partially corrected by subcutaneous heparinization and mainly by splenectomy.

Diagnosis. Direct diagnostic methods are based on the demonstration of eggs or of miracidia. Eggs may be found in the stools by the Kato-Katz quantitative method. The hatching test is a simple, cheap, and useful method, without the need for microscopy. Rectal biopsy is used in suspected cases with negative parasitological tests.
Immunologic methods, indirect immunofluorescence, indirect hemagglutination, and enzyme-linked immunoabsorbent assay (ELISA) give a high degree of positivity\(^{35,36}\). Serum precipitins have been demonstrated by immunodiffusion\(^{7}\); its low sensitivity was greatly increased by counter immunoelectrophoresis and enzyme-linked immunoelectrodiffusion assay (ELIEMA)\(^{37}\). Antibody titers are usually higher in the hepatosplenic form than in the hepatointestinal form. It is well known that antibody titers present an early and significant increase after chemotherapy as a consequence of worm death\(^{38}\).

One major diagnostic problem concerned the demonstration of periporal fibrosis, even with wedged liver biopsies. Fortunately, ultrasonography has become a reliable and sensitive method of detecting these lesions\(^{39}\).

-Ultrasoundography in schistosomiasis.- A review of the literature on the use of ultrasonography in schistosomiasis showed that ultrasonography can provide direct information on lesions in internal organs and can thus provide information about patterns of morbidity and regression of pathological changes after treatment\(^{40}\). The method is non-invasive and can be used under field conditions. However, the methodology used for ultrasonography has varied considerably so that valid comparisons between results obtained in different places or at different times are difficult to make\(^{41}\).

From the clinical point of view, periporal fibrosis, seen in ultrasonography as echodense areas along the portal vein (fig. 2), is an important diagnostic feature, and also indicates the possible existence of portal hypertension\(^{42}\). Until fibrosis reaches an advanced stage, thickened patches are typically scattered throughout the liver. Experience shows that the portal vein and the structures around it can best be visualized in the left liver lobe\(^{43}\).

A combined clinical sonographic classification of hepatosplenic schistosomiasis mansonii was proposed by Lambertucci et al\(^{44}\) for use in field-based studies. In 741 individuals out of 892 (83%) living in an endemic Brazilian area who underwent physical and parasitological examination, splenomegaly was diagnosed by abdominal palpation in 71 patients (9.6%). By using abdominal palpation and ultrasound examination, 4 groups of individuals have been identified: (i) palpable spleen and intense periporal thickening in 9 individuals (1.2%); (ii) spleen not palpable and intense periporal thickening in 15 (2%); (iii) palpable spleen with light-to-moderate periporal thickening in 32 (4.3%) and (iv) palpable spleen with a normal liver on ultrasonography in 30 (4%). Based on these results, the authors\(^{46}\) concluded that the definition of hepatosplenic schistosomiasis in field-based studies as the finding of *S. mansoni* eggs in the stools in an individual with splenomegaly is no longer acceptable.

According to recent studies, the parameters associated with variceal bleeding in patients with hepatosplenic schistosomiasis are endoscopic (variceal size, red signs, congestive gastropathy, and fumic varices) and ultrasonographic (portal vein diameter and periporal thick- ness)\(^{47}\). The most important combined parameters are gastroopathy and red signs, portal vein diameter and varical size, and varical size and gastropathy\(^{47}\).

A series of recommendations on qualitative and quantitative data obtained by ultrasonography in studies performed in Africa and Brazil were presented at a recent symposium on ultrasound in Schistosomiasis held in Minas Gerais, Brazil (Naimey-Belo Horizonte protocol). Imaging patterns of liver and portal hypertension assessment were analyzed\(^{48}\). These patterns were more recently reviewed\(^{49}\) and include: non-specific minor thickening of the walls of portal branches (‘starry sky’); fibrosis of the peripheral portal branches or of the main portal system and of the right and left branches can occur alone or simultaneously.

Finally, in agreement with previous reports\(^{49,50}\), a Doppler ultrasonographic study by our group\(^{51}\) showed that hepatic left lobe hypertrophy and right lobe atrophy are commonly observed in hepatosplenic schistosomiasis. Increased portal blood flow in patients with the hepatointestinal form of schistosomiasis, diagnosed by the absence of gastroesophageal varices and of splenomegaly and by the presence of hepatomegaly, as shown by our group\(^{52}\), would be unexpected. However, the possibility of low-grade portal hypertension not detected by clinical and ultrasonography in these patients cannot be ruled out\(^{53}\).

In summary, our group showed that portal overflow may be found in both forms of schistosomiasis\(^{54}\).

**Extrahepatic schistosomiasis**

**Gastroenteropathy.** The incidence of nephrotic syndrome and chronic renal failure is much higher in tropical than in temperate climates, suggesting that parasitic diseases, principally schistosomiasis, might be involved in the pathogenesis of glomerular disease\(^{55}\). A recent study conducted in a series of patients with schistosomal glomerulopathy allowed localization of schistosomal antigens in glomerular structures\(^{56,57}\).

The kidneys play an important role in the disposal of circulating antigens. In *S. mansoni* infection, circulating antigens derive from the adult worm (egg antigens) or from the schistosome eggs\(^{58}\). In hepatosplenic schistosomiasis the shunting of portal blood carrying the primary load of antigens into the systemic circulation is the main mechanism by which the liver may be excluded from processing the schistosomal antigens, which are then supplied to the kidneys in larger amounts\(^{59-61}\).

Earlier studies have suggested that mesangioliproliferative glomerulonephritis and membranoproliferative glomerulonephritis type I are the more common forms of schistosomal glomerulopathy\(^{62,63}\). Clinically, patients with this disease may either be asymptomatic, with only minor urinary changes, such as proteinuria or hematuria, or may manifest a nephrotic syndrome that may evolve to end-stage renal failure\(^{64}\). The transformation of mesangioliproliferative glomerulonephritis into membranoproliferative glomerulonephritis was demonstrated by De Brito et al\(^{65}\).

Nephrotic syndrome seen in association with schistosomiasis presents with an increased plasma globulin con-
centration and normal cholesterol levels in one-third of affected patients. Notably, schistosomal antigens were demonstrated for the first time in the glomeruli of humans with active schistosomiasis mansoni for the first time in the transplanted kidney of a patient with focal and segmental glomerulosclerosis and later by our group in patients with mesangioproliferative glomerulonephritis. The outcome of treatment of nephrotic syndrome associated with hepatosplenic schistosomiasis with antischistosomal drugs, corticosteroids and immunodepressors, has been disappointing.

Pulmonary forms. Pulmonary manifestations may be observed in the acute phase, but are far more common in the chronic phase. Besides the rare “pneumonias” produced by dead worms after chemotherapy, pulmonary hypertension can be found in 13% to 16% of patients with hepatosplenic schistosomiasis and, more rarely (0% to 2%), cor pulmonale. Anti-schistosomal therapy usually has no effect, but is given to prevent further progression of the disease. Pulmonary embolism of dead worms may produce an abrupt increase in pulmonary pressure.

Other forms. Other forms of schistosomiasis, including neuroschistosomiasis are clinically less important than those previously described. The course of Salmonella and Escherichia infections in patients with schistosomiasis is unusual; the infection becomes chronic with prolonged fever and blood cultures that remain positive for months. These infections can only be cured by antischistosomal treatment.

Course and prognosis

The prognosis of hepatic schistosomiasis is good in the acute and hepatointestinal forms. The prognosis of the hepatoplenic forms depends on whether the liver disease is compensated or decompensated. Fortunately, most cases belong to the compensated form; the prognosis is better than that of patients with cirrhosis. Recovery after hematemesis is rapid and patients live longer. Hepatic coma and ascites after hemorrhage are less frequent and easier to control. A few patients with severe liver failure have a poor prognosis, similar to those with cirrhosis.

Treatment

Treatment of helminthiasis. Treatment of helminthiasis is indicated in all stages and clinical forms of mansonian schistosomiasis, but some patients with a very advanced form or with unrelated conditions or diseases may not tolerate chemotherapy. There are two highly effective chemotherapeutic drugs: oxamniquine, with different doses in Latin America and Africa, and praziquantel. Both drugs are administered through the oral route. A double-blind trial published by our group in 1986 showed that both drugs have the same efficacy for the Brazilian strains of Schistosoma; however, praziquantel produces fewer neuropsychiatric symptoms. Furthermore, this drug is also effective against other species of Schistosoma. As reported by the World Health Organization, praziquantel has become the most widely used of the antischistosomal drugs. Praziquantel can also be safely given to patients with the compensated hepatosplenic form of the disease. Cessation of egg-induced immunopathology is reflected by a return to normal of serum procollagen-III-propeptide and neopterin concentrations.

Treatment of portal hypertension. Nonsurgical treatment of bleeding esophageal varices. The management of patients with esophageal and gastric varices remains challenging, particularly when prophylactic procedures are considered. Although high portal pressure and large varices are associated with an increased risk of bleeding, the literature is still not clear and the methods of measuring size and pressure are still controversial. Some endoscopic changes that are thought to indicate a high risk of bleeding include large varices, cherry-red spots, varices on varices, erosions on varices and hyperensive gastropathy. These, and probably other endoscopic signs, including ultrasonographic changes, should be used to identify patients for prophylactic procedures, including drug therapy, sclerotherapy and surgery.

1. Propranolol. β-blockers such as propranolol have mainly been used for the management of portal hypertension in liver cirrhosis. Their utility in chronic schistosomiasis, however, is not well established. In a murine schistosomiasis model, the development of portal systemic shunting was decreased or prevented by oral propranolol through the reduction of flow and pressure in the portal system.

A prospective study of 42 patients with at least one episode of gastrointestinal bleeding showed a significant reduction in episodes in treated patients when compared with a historical control. Therefore, propranolol seems to prevent patients with schistosomiasis against gastrointestinal rebleeding during the short period of time that precedes definitive surgical treatment. Indeed, oral administration of a single “blockade dose” may significantly decrease azeygos blood flow.

The same group showed that administration of propranolol corrects hyperdynamic circulation, aggravates pulmopulmonary hypertension, does not alter portal pressure and reduces segmental portal blood flows, especially of the azeygos vein, with maintenance of total hepatic blood flow. Therefore, propranolol seems to prevent patients with schistosomiasis against gastrointestinal rebleeding during the short period of time that precedes definitive surgical treatment. Indeed, oral administration of a single “blockade dose” may significantly decrease azeygos blood flow.

A controlled trial with non-cirrhotic portal fibrosis patients, most of whom had schistosomiasis, showed that continuous oral propranolol treatment is effective in preventing recurrent upper gastrointestinal bleeding. Despite these favorable results with β-blockers, we wondered whether we could obtain good compliance over a long period of time. Furthermore in some clinical trials, high...
doses of propranolol were necessary for a good pharmacological results, hampering the clinical utility of the drug\textsuperscript{38,39}.

2. Sclerotherapy of esophageal varices. In retrospective study of sclerotherapy of bleeding esophageal varices in schistosomiasis, varices were eradicated in nearly 70% of patients during a follow-up period lasting between 48 and 132 months. Sclerotherapy was effective in controlling rebleeding in 97% of the patients in the group who had previous portal hypertension surgery and in 73% of the group without previous portal hypertension surgery, with a smaller number of sclerotherapy sessions per patient in the former group; these differences were statistically significant\textsuperscript{40}. Favorable results were also obtained by another group after emergency or elective endoscopic sclerotherapy\textsuperscript{41}. A prospective non-randomized trial comparing elective sclerotherapy with a control group with a 5-year follow-up showed that the incidence of rebleeding was 28% and 45%, respectively. This difference was not statistically significant; however, mortality from rupture of esophageal varices was 3% in the sclerotherapy group and was 28% in the control group, which was a statistically significant difference\textsuperscript{41}.

Surgical treatment of portal hypertension. The morphological, hemodynamic and clinical features previously described show that mansonic schistosomiasis is an excellent model for the study of portal hypertension and of surgery used to treat bleeding varices. Until 1986, three major types of operations were used in Brazil\textsuperscript{42}: (i) esophagogastrodevascularization plus splenectomy (EGDS); (ii) Splenectomy with splenorenal shunt (SRS), and (iii) selective portal decompression (EGDS) and was more frequent after DSS (52%), although it was also present after SRS (29.6%). Because of its higher after SRS (42.9%) than after DSS (14.8%) or EGDS (7.1%). Indirect hyperbilirubinemia was absent after EGDS and was more frequent after DSS (52%), although it was also present after SRS (29.6%). Because of the absence of encephalopathy and the low mortality rates, EGDS was demonstrated to be the best option\textsuperscript{43}. As emphasized by Com\textsuperscript{44} many questions remain unanswered. For example, would endoscopic sclerotherapy with splenectomy be as effective? Would esophagogastrodevascularization without splenectomy be as effective? Our study was initiated before endoscopy sclerotherapy,

variceal ligation, β-adrenergic blockade and transjugular intrahepatic portal-systemic shunt (TIPS) became established as viable forms of therapy in portal hypertension. In our Department of Gastroenterology, patients with schistosomiasis and bleeding esophageal varices are treated with esophagogastrodevascularization with splenectomy and, if rebleeding occurs, with sclerosis of the varices\textsuperscript{45}.

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