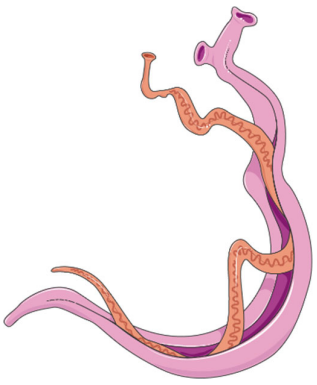
Schweizerische Fachgesellschaft für Tropen- und Reisemedizin FMH
Société Suisse de Médecine Tropicale et de Médecine des Voyages FMH
Società Svizzera di Medecina Tropicale e di Viaggio FMH
Swiss Society of Tropical and Travel Medicine FMH

Swiss TPH
Swiss Tropical and Public Health Institute
Department of Medicine
Medical and Diagnostic Services
National Reference Centre for Imported Parasitic Diseases

Schistosomiasis Treatment Recommendations 2020



25. February 2020

Schistosomiasis (acute phase)	Parasite characteristics	Diagnostics	1st-line treatment	Comments
S. haematobium ***S. mansoni*** ***S. intercalatum*** ***S. guineensis*** ***S. japonicum*** ***S. mekongi*** ***S. malayensis*** ***S. mattheei*** *Clinical picture:* *Fever, dry cough, fatigue, headache, myalgia, arthralgia, abdominal pain, diarrhoea, rarely: periorbital oedema, urticaria/rash, encephalitis, myocarditis*	Definitive host: *S. man.:* humans, primates, rodents; *S. h.:* humans, primates, pigs, buffalos; *S. i., S. g.*: humans only; *S. j.*: various domestic and wild mammals, humans; *S. me.*: dogs, humans; *S. mal.*: rats, (humans); *S. mat.*: cattle, (humans); Intermediate host: diff. fresh water snail species Route of infection: fresh water contact, penetration of skin by `cercariae´ (500 µm), development into `schistosomulae´ and then into adult worms (10–20 mm) Incubation period: 14–84 days Prepatent period: 4–6 weeks (*S. m.*) – 3 months (*S. h.*)[¥]	• Eosinophilia[¤] • PCR (blood) • (Serology[¤]) • (Circulating antigen in blood/urine [CCA, CAA][¤]) Follow-up: see below	**Prednisolone** 1–1.5 mg/kg p.o. (dose and duration according to clinic, mostly for 3–6 days) [Θ]**± Artemether/lumefantrin** [Δ]**± Praziquantel** 60 mg/kg/d p.o. (in 2 or 3 doses) on day 3 after initiation of treatment[●] [°]**± Ivermectin**[°] 200 µg/kg p.o. single dose **+** add a complete course of **Praziquantel** (see next page) once the chronic phase of infection has been reached (defined by: [A] detection of eggs in stool or urine or [B] by the elapsed time since last exposure being ≥ 3 months[¥])	• Acute schistosomiasis (AS; `Katayama fever´) is an immune-mediated serum sickness-like hypersensitivity reaction to migrating and maturing schistosomulae. AS is usually only seen in immunologically naïve patients (travellers) and not in individuals from endemic regions. • [¤] The absence of eosinophilia, circulating parasite antigen or a negative serology does not rule out AS! Eosinophilia and seroconversion may be delayed for up to 3 weeks following the onset of symptoms. Circulating antigens (CCA/CAA) become detectable in blood/urine ≥ 3 weeks post-infectionem. PCR is an emerging diagnostic tool in AS (see comment[Ø] p. 107). • [Δ] The use of PZQ in AS remains controversial. PZQ is ineffective on young (7–28 days old) schistosomulae and thus, its efficacy in AS is limited. In addition, PZQ treatment is associated with paradoxical (Jarish-Herxheimer-like) reactions in 40–59% of AS cases [2,3] (see comment[¥] below). Some experts advocate giving PZQ in AS (mostly because of the fear of acute neuroschistosomiasis; see below), others advocate delaying its use until the chronic phase of infection has been reached [4]. The concomitant use of steroids may prevent/attenuate PZQ treatment-related paradoxical reactions. • [●] Consider ruling out concomitant neurocysticercosis (by serology) in patients from endemic regions before giving PZQ, as this may provoke seizures [1]. • [Θ] Artemisinins show some activity against young schistosomulae. Adding an artemisinin to praziquantel may be beneficial. • [°] When giving high dose steroids, consider adding ivermectin to cover for possible co-infection with strongyloidiasis if patients are from high-endemic regions or strongyloides screening serology is possitive. • In some patients relapsing forms of AS have been observed (~15 days after the primary symptomatic episode).

[¥] 3 months is considered to be the maximum prepatent period in most cases. However, in rare cases the acute phase might be much longer (≥5 months) and severe treatment-induced paradoxical reactions may occur very late after infection. A high eosinophil count in the absence of detectable eggs should (irrespective of elapsed time since exposure) always raise the suspicion of an acute phase infection and the risk of treatment-induced paradoxic reactions [5].

[1] Torres JR. Use of praziquantel in populations at risk of neurocysticercosis. Rev Inst Med Trop Sao Paulo 1989;31:290.

[2] Grandière-Pérez L et al. Efficacy of praziquantel during the incubation and invasive phase of *S. haematobium* schistosomiasis in 18 travelers. Am J Trop Med Hyg 2006;74:814-8.

[3] Bottieau E et al. Imported Katayama fever: clinical and biological features at presentation and during treatment. J Infect 2006;52:339-45.

[4] Jauréguiberry S et al. Acute schistosomiasis, a diagnostic and therapeutic challenge. Clin Microbiol Infect 2010;16:225-31.

[5] Neumayr A et al. Acute febrile respiratory reaction after praziquantel treatment during asymptomatic late form of acute schistosomiasis. J Travel Med 2012;19:264-7.

Schistosomiasis (chronic phase)	**Parasite characteristics**	**Diagnostics**	**1st-line treatment**	**2nd-line treatment**	**Comments**
S. haematobium **(genitourinary S.)** ***S. mansoni*** ***S. intercalatum*** ***S. guineensis*** ***S. japonicum*** ***S. mekongi*** ***S. malayensis*** ***S. mattheei*** **(hepatointestinal S.)** *Clinical picture:* *Asymptomatic ↔* *genitourinary S.:* *haematuria, dysuria, obstructive uropathy, bladder malignancy, female infertility** *hepatointestinal S.:* *abdominal pain, chronic diarrhoea, rectal bleeding, liver fibrosis, ascites, portal hypertension, splenomegaly, variceal bleeding*[Δ]	*see above* life expectancy of adult parasite: 3–5 years (Note: although in the past the longevity of the parasite, ranging from 18 to 37 years, has been stressed, the average worm lifespan is 3–5 years)	• Egg detection in urine (*S. h.*) or faeces (other *S.* spp.) • Serology • PCR (urine/faeces) • Circulating antigen [CCA, CAA] in blood/urine[¥] • Abdominal sonography (classification of hepatic schisto-somiasis p. 105) • (Egg detection in mucosal biopsy) Recommended test-ing strategy: p. 107 If eggs are detected in faeces, check urine and vice versa to exclude double infection Follow-up: see p. 108	**Praziquantel**[●] *S. h., S. man., S. i.:* 60 mg/kg/d p.o. (in 2 or 3 doses) on day 0 and on day 21–30[†] *S. j., S. me., S. mal.:* 75 mg/kg/d p.o. (in 2 or 3 dosese) on day 0 and on day 21–30[†] ***Note:*** *A desensitization protocol for patients allergic to, but requiring PZQ treatment, has been published* [1]	***In the case of treatment failure re-treat with Praziquantel*** (*S. mansoni* <u>only</u>: **Oxamniquine** 25 mg/kg p.o. TID on day 0 and on day 21–30)[§] (*S. haematobium* <u>only</u>: **Metrifonate;** not longer produced, use obsolete due to high toxicity). ***Note:*** *A recent publication suggests that albendazole may be an effective alternative treatment option for urinary schistosomasis* [2]	• [●] Consider ruling out concomitant neurocysticercosis (by serology) in patients from endemic regions before giving PZQ, as this may provoke seizures [3]. • Cure rates of a 40–60 mg/kg single dose range from 60–90% [4,5] (see comment on the dosage of PZQ on next page). • [†] PZQ is ineffective on young (<30 days old) schistosomulae ➔ treatment needs to be repeated after all worms have reached maturity. If no (re)exposure to potential source of infection in the past 3 months (max. prepatent period), no need for a time lag between the 2 doses. • [§] Oxamniquine: only effective against *S. mansoni*; efficacy of a single dose >80%; resistance reported in Brazil and Kenya; limited availability. • Unlike travellers, patients from endemic regions often have a high parasite burden predisposing them to developing sequelae (portal hypertension, bladder cancer) ➔ screen respectively. • * Female genital schistosomiasis may affect the entire genital tract, manifesting as pain, contact bleeding, and infertility. • *S.h.* may occasionally cause hepatic complications as well. • In the absence of concomitant hepatic morbidity, impairment of hepatic function/hepatocellular failure is rare even in long-standing infections as schistosomiasis is characterized by liver fibrosis rather than cirrhosis. • [¥] Antigen detection is indicative of active infection/treatment failure and would thus be more useful than serology. However, sensitivity is still unclear (especially in travellers in whom parasite density is mostly low) and currently only one point-of-care (POC)/rapid diagnostic test for CCA detection in urine is commercially available. For details, see comment 'laboratory testing / screening for schistosomiasis…' p. 107. • [Δ] *Transjugular intrahepatic portosystemic shunt* (TIPS) has been successfully used for prophylaxis of variceal bleeding [6,7].

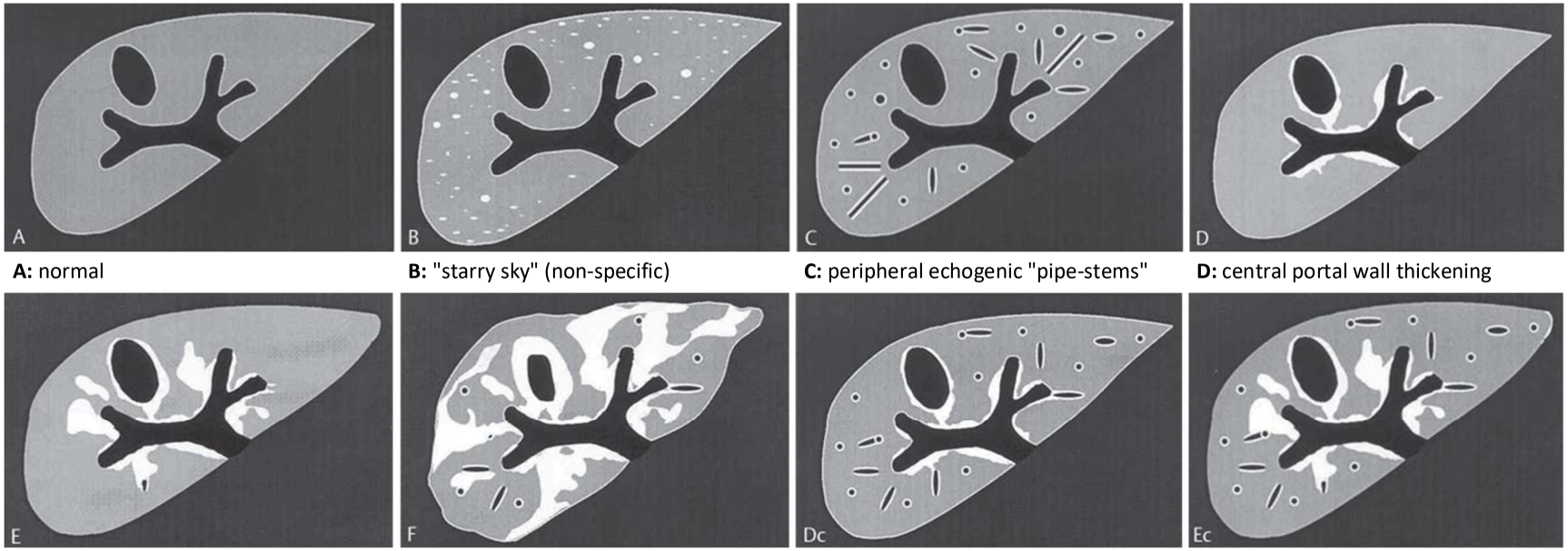
[1] Patel TA et al. Treatment of schistosomiasis in a patient allergic to praziquantel: a praziquantel desensitization and treatment protocol. Am J Trop Med Hyg 2016;95:1041-3.
[2] Ben SA et al. A comparative study on the efficacy of praziquantel and albendazole in the treatment of urinary schistosomiasis in … Nigeria. Int Health 2017;9:288-93.
[3] Torres JR. Use of praziquantel in populations at risk of neurocysticercosis. Rev Inst Med Trop Sao Paulo 1989;31:290.
[4] Elbaz T et al. Hepatic and intestinal schistosomiasis: review. J Adv Res 2013;4:445-52.
[5] Helleberg M et al. High rate of failure in treatment of imported schistosomiasis. J Travel Med 2010;17:94-9.
[6] Richter J et al. Severe liver fibrosis caused by *S. mansoni*… Lancet Infect Dis 2015;15:731-7.
[7] Kraef C et al. Transjugular intrahepatic portosystemic shunt (TIPS)… TMAID 2019;30:130-2.

Good reviews on schistosomiasis: Colley DG et al. Human schistosomiasis. Lancet 2014;383:2253-64.
Weerakoon KG et al. Advances in the diagnosis of human schistosomiasis. Clin Microbiol Rev 2015;28:939-67.

Comment on the praziquantel dosage recommendations in *S. haematobium* and *S. mansoni* infection:
The recommended regimens vary widely, ranging from 40 mg/kg single dose to 40 mg/kg for 3 consecutive days. The WHO recommended single dose 40 mg/kg regimen is derived from studies conducted in endemic regions, where cyclic mass drug administration primarily aims at parasite reduction rather than parasite eradication. In addition, the treatment outcome in these studies was assessed by investigating a single urine- or stool sample, which has low sensitivity. Considering that (i) the failure rate in *S. mansoni* treatment studies decreases with increasing doses (20mg/kg: 51%; 30mg/kg: 35%; 40mg/kg: 23%; 60mg/kg: 17%)[1], (ii) that PZQ is generally very well-tolerated, and (iii) that in individual treatment parasite eradication rather than parasite reduction is the goal, several specialists recommend to use higher dosages than recommended by WHO (e.g. the German Society for Tropical Medicine recommends treating with 40 mg/kg for 3 consecutive days [2]).

[1] Danso-Appiah A et al. Drugs for treating *S. mansoni* infection. Cochrane Database Sys Rev 2008:3:CD000528. [2] https://www.dtg.org/empfehlungen-und-leitlinien.html

Ultrasound classification of hepatic (periportal) fibrosis associated with chronic hepatointestinal schistosomiasis:



A: normal

B: "starry sky" (non-specific)

C: peripheral echogenic "pipe-stems"

D: central portal wall thickening

E: central portal wall thickening with echogenic "patches" protruding into the parenchyma

F: echogenic abnormalities reaching from the portal hilus to the Glisson capsula ("bird's claw")

Dc: combined central and peripheral periportal abnormalities (D+C)

Ec: combined central and peripheral periportal abnormalities (E+C)

Good review on sonographical aspects of schistosomiasis: Richter J et al. Ultrasound assessment of schistosomiasis. Z Gastroenterol 2016;54:653-60.

Comment on MRI assessment of schistosomiasis-related hepatic fibrosis: It has been tried to assess hepatic (periportal) fibrosis by MRI and to correlate MR and ultrasound imaging patterns. However, the correlation between MRI and ultrasound patterns is poor (Silva LC et al. *Schistosoma mansoni*: magnetic resonance analysis of liver fibrosis according to WHO patterns for ultrasound assessment of schistosomiasis-related morbidity. Mem Inst Oswaldo Cruz. 2010;105:467-70).

Treatment of schistosomiasis in pregnancy and during breast feeding:
To date, no praziquantel-related mutagenic, teratogenic or embryotoxic effects have been observed. Although human data are limited, a strong argument for treatment is that active infection poses a threat to the mother as well as to the foetus. For details and references on the use of praziqantel in pregnancy and during breast feeding; see drug profile p. 164.

Neuroschistosomiasis	*Diagnostics*	*Treatment*		*Comments*
Schistosomal myeloradiculopathy *All S.* spp. *may infect the CNS; spinal cord involvement is most frequently caused by S. haematobium and S. mansoni*	*see above +* • MRI (gadolinium-DTPA), CT • CSF: - Eosinophilia (40% of cases) - Raised protein level (90% of cases) - Raised mononuclear cell count • (Biopsy¤)	+ **Methylprednisolone** 15 mg/kg/day (max. 1 g) for 5 days followed by **Prednisolone** 1 mg/kg/day for up to 6 months (+ tapering after 4 weeks)☜ + **Praziquantel** 60 mg/kg/day p.o. in 2–3 doses on days 30, 60 and 90 + *consider empirically adding* **Ivermectin** 200 µg/kg p.o. single dose°	Adjunct supportive treatment: - Pain therapy - Physiotherapy - Urinary bladder catheterization - Early diagnosis and treatment of urinary tract infections - Decubitus prophylaxis - Psycho-/occupational therapy	• Neuroschistosomiasis (NS) is rare, but may be seen in up to 2–5% of infected patients. • Neuroschistosomiasis results from ectopic egg deposition in the CNS and neurological symptoms result from the host's inflammatory response to the antigens released by parasite eggs. • Eggs may reach the CNS by embolisation from the portal, mesenteric, and pelvic venous system or as a result of the anomalous migration of adult worms, followed by in situ egg deposition. The occasional finding of adult *S. mansoni* within leptomeningeal veins and the presence of eggs grouped together in a confined area also suggest migration of the parasite to the CNS. • ¤ In clinical practice, a presumptive diagnosis of NS is made based on clinical, laboratory, and epidemiological data (and once other differential diagnoses have been ruled out), as confirmation by biopsy is mostly not feasible. • CNS involvement in schistosomiasis can occur in acute primary infection.
Cerebral schistosomiasis *All S.* spp. *may infect the CNS; cerebral schistosomiasis is most frequently caused by S. japonicum*		***In the absence of signs of intracranial hypertension:*** **Prednisolone** 1 mg/kg/day for 2 months (+ tapering) + **Praziquantel** 60 mg/kg/day p.o. in 2–3 doses on days 30, 60 and 90 + *consider empirically adding* **Ivermectin** 200 µg/kg p.o. single dose° + **anticonvulsive treatment** if patient presents with seizures	***If signs of intracranial hypertension are present:*** Primarily neurosurgical approach and removal of lesion(s) followed by medical treatment	

° When giving high dose steroids, consider adding ivermectin to cover for possible co-infection with *Strongyloides stercoralis* (especially in patients from highly endemic regions).
☜ Stopping steroid treatment before 6 months of treatment should only be considered if the patient has fully recovered from the neurological symptoms [1].

Good reviews on Neuroschistosomiasis: [1] Vale TC et al. Neuroschistosomiasis mansoni: literature review and guidelines. Neurologist 2012;18:333-42.
[2] Carod Artal FJ. Cerebral and spinal schistosomiasis. Curr Neurol Neurosci Rep 2012;12:666-74.

Laboratory testing / screening for schistosomiasis in travellers and migrants:

I. Screening of asymptomatic persons (Note: screening should not be done earlier than 2 months after the last potential exposure[†])

Serology[†]
+ Eosinophile count[‡]
(± urine POC-CCA testing[§] [always + routine urine dipstick testing for WBC and RBC])

In the case of a positive serology result, perform stool and urine microscopy as in symptomatic persons (see below).

II. Testing of symptomatic persons

Microscopy* of 3 urine[Δ] and 3 stool samples for eggs (depending on the geographic prevalence of the different *Schistosoma* spp.; maps see p. 185)
+ Serology[†]
+ Eosinophile count[‡]
(+ urine POC-CCA testing[§] [always + routine urine dipstick testing for WBC and RBC])
(± blood PCR)[Ø]

[†] As the sensitivity of serology is superior to microscopy and the presence of eosinophilia, serology is the primary screening tool [1]. Serological assessment should include at least 2 different *schistosoma* specific assays. Serological screening should not be done earlier than 2 months after the last contact to potentially infectious fresh water, to allow for full development of the parasite and formation of antibodies to the adult stage (IgM levels peak at 12–16 weeks, IgG levels around 20 weeks after infection). In the case of positive serology also consider cross-reactivity; see p.136.

[‡] Note that eosinophilia is not always present (travellers: ~50%, migrants: 15–30%). Especially in chronic infection (e.g. endemic populations and migrants) eosinophilia is frequently absent or may be attributable to other causes (e.g. strongyloides or filarial infection etc.).

[§] Antigen detection is indicative of active infection/treatment failure and would thus be more useful than serology which may remain positive for years even after successful treatment. The diagnostic role and sensitivity of circulating antigens (CCA, CAA) still remains to be defined, especially in asymptomatic patients with a low parasite burden (e.g. travellers). Currently, only one point-of-care (POC)/rapid-diagnostic-test for schistosomal antigen detection is commercially available: a urine CCA (Circulating Cathodic Antigen) cassette test [Rapid Medical Diagnostics, South Africa; http://www.rapid-diagnostics.com] with a sensitivity of 70–100% (largely depending on the intensity of infection) and a specificity of ~95%, according to the manufacturer). **Comment:** The highest concentrations of CCA are detected in *S. mansoni* infections and, therefore, the test is particularly useful to diagnose *S. mansoni* infections. CCA levels in *S. haematobium* infections are variable and appear to differ between regions, which lowers sensitivity. False-positive results due to urinary tract infection, haematuria, and pregnancy have been reported. This is primarily attributed to the fact that the polysaccharide structure of CCA contains repeating units of Lewis-X trisaccharide, a molecule which is a common epitope on human cells (especially anti-inflammatory cells like granulocytes). Therefore, always perform parallel testing of the urine with a routine dipstick test to exclude asymptomatic urinary tract infection and/or haematuria! A recent study showed that the combination of serology + urine POC-CCA testing is the most sensitive screening option for asymptomatic *S.mansoni* infection in Eritrean refugees and superior to stool microscopy [4]. In travellers, the role of the commercially available urine POC-CCA test for screening is currently unclear. Our own experiences suggest that specificity is problematic in this population and that positive results should be interpreted with caution.

* In infected travellers, microscopy has a sensitivity of only ~60%, as the parasite load is mostly very low. Therefore, investigate a minimum of 3 stool and 3 urine samples (collected on different days) and additionally use serology (± urine POC-CCA ± PCR).

[Δ] The recommended time for collecting urine is from 10:00 a.m. to 2:00 p.m. [2,3]. Collect as much urine as possible. Whether the traditionally recommended physical exercise before collecting urine samples (`exercise urine´ [e.g. hopping in place, running up and down the stairs before voiding urine]) increases the sensitivity of urine microscopy has recently been questioned [5].

[Ø] PCR is an emerging diagnostic tool, especially in acute schistosomiasis [6]. Sensitivity and specificity may be superior to conventional diagnostic methods. However, if used for follow-up, it must be considered that parasite-DNA may circulate for several months after successful treatment.

[1] Bierman WF et al. Presentation and diagnosis of imported schistosomiasis: relevance of eosinophilia, microscopy for ova, and serology. J Travel Med 2005;12:9-13.
[2] Doehring E et al. Day-to-day variation and circadian rhythm of egg excretion in urinary schistosomiasis in the Sudan. Ann Trop Med Parasitol 1983;77:587-94.
[3] Doehring E et al. Circadian variation of ova excretion, proteinuria, hematuria, and leukocyturia in urinary schistosomiasis. Kidney Int 1985;27:667-71.
[4] Chernet A et al. Accuracy of diagnostic tests for *S. mansoni* infection in asymptomatic Eritrean refugees: serology and POC-CCA against stool microscopy. CID 2017;65:568-74.
[5] Coulibaly JT et al. *Schistosoma haematobium* egg excretion does not increase after exercise: implications for diagnostic testing. Am J Trop Med Hyg 2018;98:772-5.
[6] Soentjens P et al. Diagnosing acute schistosomiasis. Clin Infect Dis 2014;58:304-5.

Work-up of schistosomiasis patients suspected to be infected >1 year:

1. Assess liver (GOT, GPT, gGT, AP, albumin, INR) and kidney (creatinine or cystatin C) function
2. Check for concomitant chronic viral hepatitis B/C infection in patients from endemic regions
3. Sonographical assessment (hepatoportal pathology? [see p. 105]; genito-urinary pathology? [if present rule out bladder malignancy and urogenital tuberculosis]).
4. Women: gynaecological assessment to rule out concomitant genital involvement (vulvovaginal ulcera, fibrotic nodules [`sandy patches´])

Follow-up after treatment of schistosomiasis:

I. Parasitologically confirmed schistosomiasis (= eggs found at initial assessment):

1. Check 3 urine and/or 3 stool samples for eggs at 3, 6 and 12 months after treatment*
2. If eosinophilia was initially present, check differential blood count at 3 and 6 months after treatment. Eosinophilia should be cleared at 6 months after treatment ‡
3. (If urine POC-CCA was initially positive, consider repeating urine POC-CCA testing after 3 months§)
5. If initially present, follow-up hepatic and/or urogenital pathologies by imaging

II. Serologically diagnosed schistosomiasis:

1. If no eosinophilia was initially present, consider checking the eosinophil count at 7 days† (and if then positive, at 3 and 6 months) after treatment
2. If eosinophilia is present, check differential blood count at 3 months and 6 months after treatment; eosinophilia should be cleared at 6 months after treatment†‡
3. If initially present, follow-up hepatic and/or urogenital pathologies by imaging

* Because praziquantel is not ovicidal and eggs must migrate through host tissue to reach the stool/urine, egg shedding can persist for some time even after successful treatment. Eggs become avital within 3 months after being laid. Vitality of eggs can be assessed by microcopy (± a hatching test). Detection of vital eggs ≥ 3 months after treatment indicates treatment failure or reinfection.

§ Specificity of urine POC-CCA is considerably lower than its sensitivity. Thus, we recommend not generally using urine POC-CCA for follow-up.

† Eosinophil counts may transiently rise just after praziquantel therapy (which would support the suspected diagnosis in only serologically diagnosed cases). In these cases, normalization of eosinophil count is sometimes slow. In case of a persistently elevated eosinophil count consider an alternative aetiology and screen for strongyloidiasis (± other parasites).

‡ Serological assays remain positive for prolonged periods (frequently up to several years) and may show a fluctuating titer pattern over time. Therefore, unlike other helminth serologies (e.g. strongyloides, filaria, etc.), serological follow-up has no major role in post-treatment monitoring of schistosomiasis.

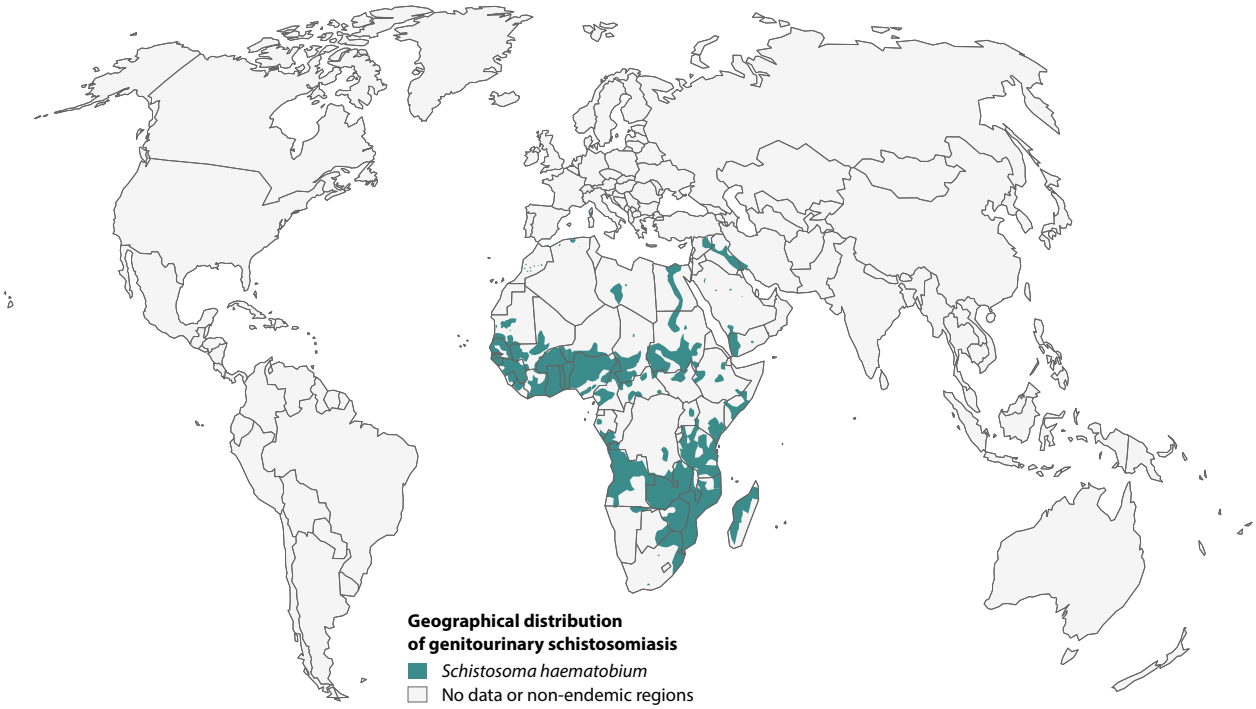
Diagnostic pit-falls in schistosomiasis:

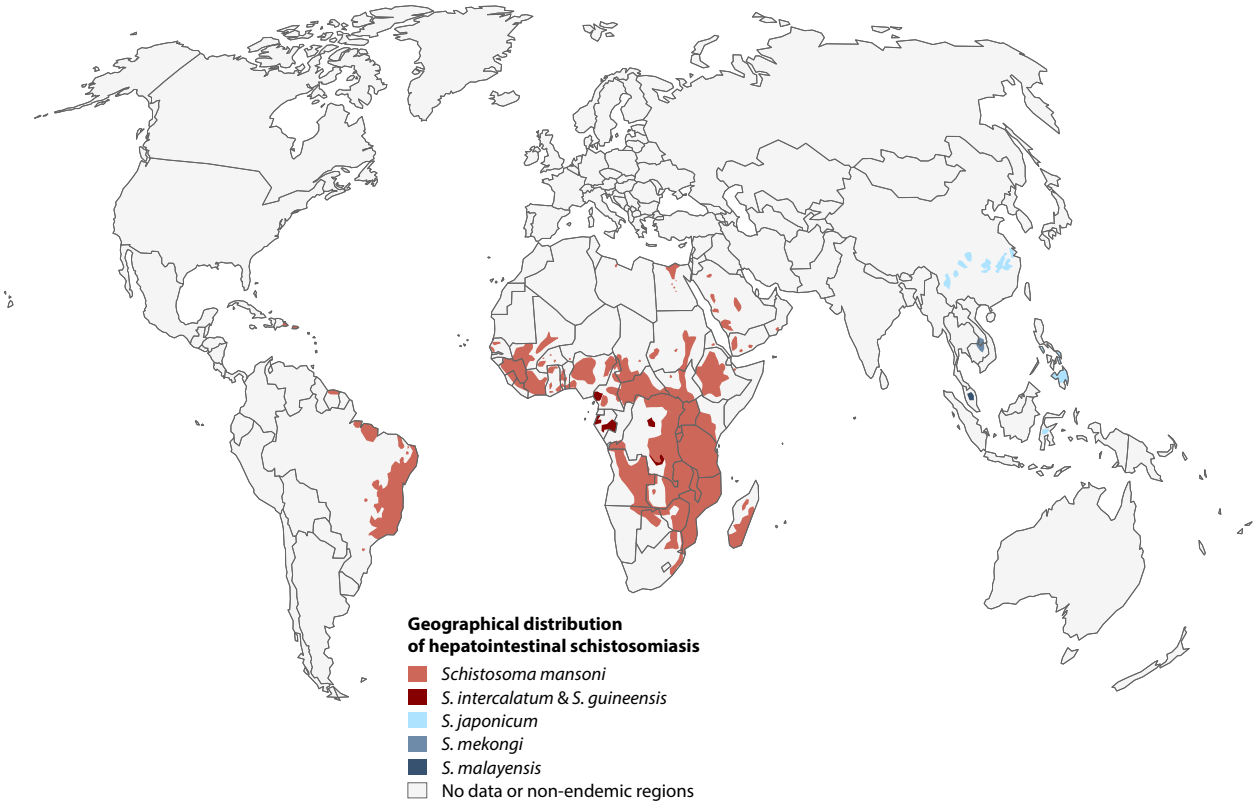
- False-positive *P. falciparum* histidine-rich protein 2 (HRP-2) immune-capture assay results may be caused by acute schistosomiasis due to *S. mekongi*
  [Leshem E et al. False-positive *P. falciparum* histidine-rich protein 2 immunocapture assay results for acute schistosomiasis caused by *S. mekongi*. J Clin Microbiol 2011;49:2331-2].
- Serology: be careful in the case of the following constellation:
  - Schistosoma egg-antigen ELISA: very high positive
  - Schistosoma adult-antigen ELISA: negative – low positive
  - IFAT: negative

  } constellation is a characteristic cross-reaction in ***hepatic capillariasis*** (see p. 28)

Epidemiology of schistosomiasis: Map see p. 185.

Schistosomiasis





Human pathogenic *Schistosoma* spp.: *S. haematobium*: Africa, the Middle East, Corsica; *S. mansoni*: Africa, the Middle East, the Caribbean, Brazil, Venezuela, Suriname; *S. japonicum*: China, Indonesia, the Philippines; *S. mekongi*: Mekong river in Southern Laos (Si Phan Don region) and some districts in Cambodia [Muth S et al. *S. mekongi* in Cambodia and Lao PDR. Adv Parasitol. 2010;72:179-203]; *S. intercalatum* and related *S. guineensis*: Rain forest areas of central Africa; *S. malayensis*: closely related to *S. mekongi*, few transmission sites on the Malaysian Peninsula, infections confined to rural aboriginal communities [Latif B et al. Autochthonous human schistosomiasis, Malaysia. EID 2013;19:1340-1]); *S. mattheei* (not shown on map): primarily a zoonosis of cattle, human cases reported from South Africa. Schistosomiasis cases reported in Myanmar in 2018, species unknown [http://www.promedmail.org/direct.php?id=20180329.5717098].

Detailed maps providing epidemiological data on country level: http://www.who.int/schistosomiasis/epidemiology/global_atlas_maps/en/

Maps by Rosalie Zimmermann & Andreas Neumayr, adapted from WHO maps 92720 and 92721, Gryseels B. Lancet 2006;368:1106-1118 and IAMAT World Schistosomiasis Risk Chart 2015