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REVIEW

Schistosomiasis in travellers and migrants

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Summary Schistosomiasis is a tropical parasitic disease caused by blood-dwelling fluke worms of the genus *Schistosoma* whose infective stages, the cercariae, are amplified through mollusks acting as intermediate hosts. People are infected when exposed to fresh water containing cercariae that penetrate the skin. There are however considerable differences in intensity of infection and morbidity, depending on the pattern of exposure and the infective species. In travellers, schistosomiasis differs substantially from infection in endemic populations in many aspects: geography, morbidity, treatment and prevention. In migrants, schistosomiasis manifests itself in a way more akin to what is seen in endemic populations. In this paper we will review the specific issues associated with schistosomiasis in travellers and migrants, with emphasis on the acute disease manifestations in non-immune persons, and on neuroschistosomiasis as a potential severe complication. We discuss new trends in diagnosis and treatment with respect to the specific disease stage, and summarize precautionary measures and novel ways to prevent *Schistosoma* infection in travellers.

Introduction

Schistosomiasis (or bilharziosis) is a tropical parasitic disease caused by blood-dwelling fluke worms of the genus *Schistosoma* (Phylum Platyhelminthes, Class Trematoda). The infection is amplified by fresh water mollusks acting as intermediate hosts, and acquired through infective cercariae penetrating the skin (Fig. 1). There are however considerable differences in intensity of infection and morbidity. Nowadays the bulk of schistosome morbidity, both gastrointestinal and urogenital, is found in Africa and the eastern part of South America, and to a lesser extent in Arabia, China and South East Asia.[1–4] In Africa and South America, human schistosomiasis is usually a stable disease but may evolve rapidly in newly infected populations.[5,6] Occupational as well as recreational contact play a major role in acquiring a significant parasite burden.[7,8]

The human schistosomes produce essentially hepatointestinal disease (*Schistosoma mansoni*, *Schistosoma japonicum*, *Schistosoma intercalatum*, *Schistosoma mekongi*) and urogenital disease (*Schistosoma haematobium*).[9–14] *S. intercalatum* (pockets in West and Central Africa) and *S. mekongi* (downriver parts of the Mekong river basin in Laos and Cambodia) are only of local importance.[15,16]

Human schistosomiasis is mainly restricted to a human reservoir (*S. haematobium*, *S. intercalatum*) but animals

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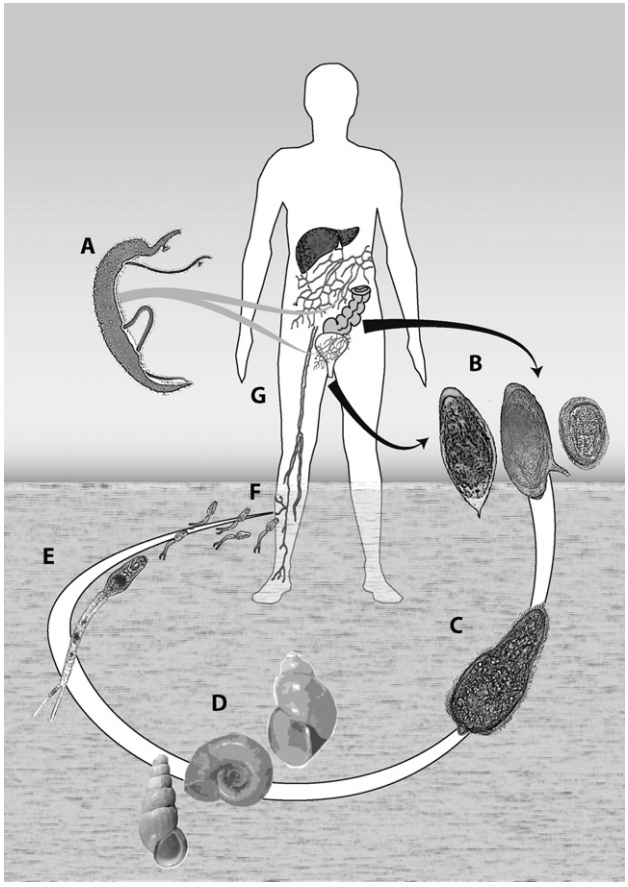

Figure 1 Life cycle of human schistosomiasis. A. Paired adult schistosomes. B. Excreted schistosome eggs (feces or urine). C. Miracidium larva in aquatic environment. D. Mollusks as intermediate hosts. E. Cercaria: infective larval stage. F. Penetration through skin. G. Developing stages in human host.

play a potentially important role as a transmission reservoir: rodents and primates for *S. mansoni*, and rodents, pigs and water buffaloes for *S. japonicum* and *S. mekongi*. In the latter two, the infection is in fact predominantly zoonotic.[17,18] Extensive treatment programmes have substantially reduced prevalence and disease manifestations in some heavily exposed populations, and may in the end reduce risk of infection as well.[19]

Schistosomiasis has been repeatedly reported in series of travellers and immigrants having undergone a post-travel examination. Prevalence ranges from 1% to 76% depending on the definitions used.[9,20–29] Travellers are almost exclusively infected while visiting Sub-Saharan Africa. Acute schistosomiasis is a significant cause of fever in travellers infected for the first time.[25,30–32] In travellers, chronic infection seldom results in major pathology.

Epidemiology

General epidemiology and transmission cycle

The completion of the parasite cycle requires contamination of these surface water by human excreta, either feces or urine, containing schistosome eggs, and regular contact with fresh water, harboring the infective cercaria. Notwithstanding these conditions, the epidemiology of schistosomiasis and the intensity of infection vary considerably between regions and localities. Fresh water mollusk populations, cercarial densities and human water contact show strong temporal and spatial variations, depending on local ecology.[3,4,7,33–37] The aquatic African vector snails *Biomphalaria* and particularly *Bulinus* can survive protracted droughts.[38]

Transmission of both species not only happens in rivers, ponds and lakes; irrigation systems play an important role in the local endemicity of schistosomiasis.[6]

The suitable intermediate snail host thrives only in a fresh water environment with a minimum temperature of 18 °C. Therefore the disease usually does not occur in African fresh water lakes above 2000 m altitude. *S. haematobium* mostly occurs in low lying plains of Africa, *S. mansoni* can be transmitted in a variety of ecotypes, from steaming valleys and savannah to rain forest and highlands.[2,36]

In East Asia, the parasitized *Oncomelania* snail survives long and cold winters, essential to complete the cycle of *S. japonicum*.[39] This species is endemic in the subtropical southern parts of China, along the Yang-tse river basin as well as in the mountains of Sichuan and the Central lake areas, where winters are severe but where warm summers allow intense seasonal transmission. It is also found in a few remote rural areas in the Philippines and in Indonesia.[40–42] *S. japonicum* causes the most severe form of hepato-intestinal disease, with early hepatofibrosis, portal hypertension and a febrile stage recurring at reinfection, the so called "Katayama fever".[43]

Epidemiology in travellers and expatriates

There is a considerable difference in exposure to schistosomiasis between travellers and indigenous people living in endemic areas. In the vast majority of western travellers and expatriates, exposure is occasional and short-lived, and is mainly recreational.

Travellers and expatriates contract schistosomiasis during a leisure activity (water sports like rafting, swimming or just taking a refreshing shower in a natural cataract), and are rarely occupational.[30–32,44–47] Travellers have been infected as well when taking a plunge in a swimming pool supplied with apparently clean water directly pumped from an infected small river.[48] Agronomes, surveyors of any kind and hobbyists of aquatic life may be at particular risk. In some series of expatriates being repeatedly infected, children constitute the majority of ova-excreting patients and often carry the highest parasitic burden.[49] It is not clear whether the intensity of exposure or immunological modulation is the main determinant here.

Only a handful of large studies on imported schistosomiasis exist to date, and there is no uniformity in defining the diagnosis, clinical presentation and the origin of infection.[23,50–54] Selection bias is therefore unavoidable (Table 1). In most reported series, diagnosis is predominantly made by antibody testing. The worm burden is mostly low, and often does not allow to determine the infecting schistosome species in feces or urine. Also the vast majority of the