**Abstract**

Schistosomiasis is the second most prevalent parasitic disease after malaria. According to the Schistosomiasis Control Initiative (SCI), 200 million humans are infected with schistosomiasis globally, of whom 170 million are living in Africa. Praziquantel is the most frequently used therapy against schistosomiasis and is the only treatment endorsed by the World Health Organization. In the late 1980s an outbreak of praziquantel-resistant schistosomiasis signaled the need for additional therapies to the disease. This article reviews therapies for treating schistosomiasis.

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**Introduction**

Schistosomiasis is a parasitic disease endemic in many countries in Africa. Eggs escape an infected human through feces or urine, and then hatch in water, and their larvae then penetrate a snail host, wherein cercariae develop and eventually emerge from the snail host to penetrate a new human host through unbroken skin. The cercariae mature as worms in the body and then migrate to the lungs, liver, and veins of the abdominal cavity or the bladder plexus.

The 3 species of the schistosome parasite found in Africa are Schistosoma mansoni, Schistosoma haematobium, and Schistosoma intercalatum. Infection of S haematobium causes urinary schistosomiasis, whereas S mansoni and S intercalatum cause intestinal schistosomiasis. At higher risk of the parasite are children, fishermen, farmers, and women doing domestic tasks with water drawn from infested sources.

Hycanthone, niridazole, and metrifonate are drugs previously used to treat schistosomiasis before praziquantel became available: after that, treatment with the earlier drugs became less acceptable because of side-effects and cost.(1,2) Hycanthone has been reported to have low efficacy in children and have side effects such as nausea and vomiting.(3,4) Niridazole requires multiple doses and side effects include kidney toxicity and immunosuppression.(3) Metrifonate is effective against schistosomiasis, well-tolerated, and was once more cost-effective than praziquantel.(3) However, multiple doses are needed and after the price of praziquantel treatment decreased metrifonate, metrifonate was no longer the first-line choice for antischistosomal therapy.

Praziquantel has been the primary therapy for the disease since the 1970s. Oxamniquine, artemether, and artesunate are drugs being tested as an alternative treatments for schistosomiasis, and researchers are also investigating traditional remedies as possible cures or molluscicides. This article reviews all 4 drugs and considers possibilities of traditional remedies for more drugs or snail control.

**Methods**

Schistosomiasis was searched on the WHO online resources http://www.who.int and Schistosomiasis Control Initiative online resources http://www.schisto.org. Additionally, PUBMED was searched for the terms "schistosomiasis," "schistosomiasis therapies," "praziquantel," "oxamniquine," "artemether," "artesunate," "traditional schistosomiasis therapies", and the Clinical Trials Registry was searched for "schistosomiasis".

**Results and Discussion**

**PRAZIQUANTEL**

Praziquantel is the only pharmaceutical effective against all schistosomiasis species infections, and has been the primary therapy for the disease since the 1970s.

At the cost of USD1 per tablet, the price was too high in the poor, endemic countries where the drug was most necessary. In the 1990s, new methods of manufacturing the generic form of the drug were developed by a pharmaceutical company in China, and the cost of a single dosage of praziquantel dropped by 90%. (5) Currently, WHO reports the cost of a complete praziquantel treatment is between USD0.20 to 0.30. This cost coupled with the drug's success rates make it the only drug endorsed by WHO for treatment of schistosomiasis. (6)

In 1988, the ecological changes that accompanied the construction of the Diama Dam resulted in an increase in S haematobium infection, and introduced S mansoni to the region. (8) Before the Diama Dam became operational in 1988, S mansoni was detected in 1.9% of stool samples in the Richard Toll...
region of the Senegal River Basin; in the last quar-
ter of 1990, stool S mansoni was detected in 71.9% of that population. Cure rates with praziquantel dropped, and though this was later attributed to high transmission and rapid reinfection of S mansoni and S haematobium from the waters, this incidence launched an effort to review alternative therapies to curing schistosomiasis. Praziquantel is still used as the primary therapy against all forms of schistosome infection in Africa, though the incidence of decreased efficacy of the drug stresses the importance of identifying alternative antischistosomal drugs.

OXAMN QUI NE

Oxamniquine is a drug used for intestinal schistoso-
miasis, and is only effective against S mansoni. Oxamniquine forces the worms through the mesen-
tery veins to the liver where they are destroyed. Oxamniquine is not used in Africa as often as prazi-
quintel, but has been used extensively in Brazil, another country with endemic schistosomiasis. Oxamniquine has been found more effective on the male parasite, though female worms may become unable to produce eggs, and some researchers report cure rates from 80 to 90%. Oxamniquine was tested after the outbreak of S mansoni infection in northern Senegal, and some studies found higher cure rates with oxamniquine than with praziquantel. However, in the majority of studies reviewed, praziquantel is more effective than oxamniquine in curing intestinal schistosomiasis.

ARTEMETHER

Malaria is the main disease for which artemether is marketed. Shuha et al tested artemether against juvenile S mansoni in laboratory animals, and found that S mansoni did not mature in tested animals which had been treated with artemether in the first month of infection. Artemether has also been tested on laboratory ani-
mals injected with S haematobium and it was found to be effective on juvenile S haematobium, with worm reduction rates found on a 77-day old adult S haematobium. A study published in the British medical journal Lancet reported a lower incidence of S mansoni infection when subjects were treated with artemether. A 2003 study also found antischis-
tosomal activity when patients with S haematobium were treated with artemether.

ARTESUNATE

Artesunate is another antimalarial drug; one of the artemisinin class of drugs. Studies have been undertaken to tested artesunate on school children infect-
ed with the S haematobium parasite in Senegal and Nigeria. Results from one of these studies were that artesunate was 70.1% effective in treating endemic urinary schistosomiasis in a Nigerian community. Artesunate has been tested clinically on children with uncomplicated malaria and with S haematobi-
um eggs present in their feces. At the 28-day follow up, the S haematobium egg count was determined to have decreased in 95% of these children.

Traditional Remedies

When access to pharmaceutical therapies, also known as biomedicine, is unattainable, traditional medicine is an option. Traditional healing is the primary source of health care in up to 80% of South African communities, according to a single study on antischistosomal herbal remedies. WHO reports that scientific researchers have turned to traditional healers to investigate the symptoms and diagnosis of schistosomiasis, and the traditional medicines used to aid the disease. These studies consist of gathering plants recommended by the traditional healers, and examining their antischistosomal capability. Sparg et al found Berkheya speciosa (Asteraceae), Euclea natalensis (Ebenaceae) and Trichilia emetica (Meliaceae) will terminate the schistosomula of S haematobium. Molgaard et al reported finding Abrus precatorius (Fabaceae) and stem bark from Elephantorrhiza goetzei (Mimosaceae) were effective against S mansoni, based on further study from Ndamba et al. Ndamba et al reported Abrus precatorius (Leguminosae), Pterocarpus angolensis (Leguminosae) and Ozoroa insignis (Anacardiaceae) were effective as antischistosomal therapies when the infecting species was S haematobium.

Conclusions

Praziquantel still remains the most effective antischistosomal treatment for this neglected tropical disease. Research into the 3 alternative drugs discussed shows promise of development of alternative treatments to praziquantel: particularly promising is the antimalarial drug artemether.

References

1. Shekhar KC. Schistosomiasis drug therapy and treatment consid-


