

Efficacy of Praziquantel in Treating Natural Schistosome Infections in Common Mergansers

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ABSTRACT: Fifty-one common mergansers were captured on Douglas Lake (Cheboygan County, Michigan) and their avian schistosome loads were determined by fecal examination. Each bird was given a single dose of 0, 40, or 200 mg/kg of body weight of praziquantel and released. All birds were recaptured within 10 days of drug administration to determine posttreatment schistosome loads. Only the highest dose of praziquantel was found to significantly reduce avian schistosome loads. The potential use of praziquantel in swimmer's itch control programs is discussed.

First developed in Germany in the late 1970s as a chemotherapeutic agent against human schistosome infections (Seubert et al., 1977), praziquantel is now prescribed routinely by veterinarians to treat a variety of flatworm-related diseases. To date, it has been used successfully against paragonimiasis (Kern, 1991), toxocarasis (Llyod and Gemmell, 1992), giardiasis (Barr et al., 1998), and echinococcosis (Jenkins, 1998). It was this broad spectrum of anthelmintic activity that led Blankespoor and Reimink (1991) to suggest using praziquantel against avian schistosomes, the causative agents of swimmer's itch. Initial laboratory studies, which were later supported with field trials (Reimink et al., 1995), showed that oral administrations of praziquantel significantly reduced avian schistosome levels in mallards (*Anas platyrhynchos*).

We here report that praziquantel is also effective at killing adult schistosomes in common mergansers (*Mergus merganser*). The results of the present study may have a profound impact on swimmer's itch control programs because common mergansers typically have a higher prevalence and intensity of schistosome infection than mallards (Blankespoor and Reimink, 1991). Using a modified drive trap, 8 female common mergansers and their broods, comprising a total of 51 birds, were captured on Douglas Lake (Cheboygan County, Michigan) during the summers of 1996 and 1998. Captured individuals were aged, vent-sexed, and banded with U.S. Fish and Wildlife leg bands. A fecal sample was obtained from each bird, weighed, diluted in conditioned water, and exposed to fluorescent light for 2 hr to induce the hatching of miracidia. By counting the number of miracidia in the sample, a pretreatment avian schistosome load (number of viable eggs per gram of feces) was determined for each individual.

Praziquantel, in both pill and liquid forms, was obtained from Bayer Corporation and stored at 4 C until an hour before being used in a trial. Within a few hours after capture, individual birds were given 1 of the following randomly assigned drug treatments: 40 mg/kg body weight (intramuscular [IM]), 40 mg/kg (oral), 200 mg/kg (IM), or 0 mg/kg (avian ringers) (IM). These titers were chosen because they represent either 1× or 5× the manufacturer's recommended dosage for pets. Immediately after treatment, birds were released on the lake near the location of their capture.

Broods were recaptured within 10 days of treatment and in-

dividual posttreatment schistosome loads were determined. Data were analyzed using a Kruskal–Wallis test with Tukey's multiple comparisons; *P*-values were adjusted using the sequential Bonferroni technique (Rice, 1989) to maintain an experiment-wide α at 0.05.

As is evident from Figure 1, pretreatment parasite loads were similar across all groups ($\chi^2 = 0.466$, *P* = 0.93). Moreover, praziquantel administered at the manufacturer's recommended dosage for cats (40 mg/kg), whether injected or orally administered, had little effect on the natural schistosome loads in common mergansers. By comparison, oral administrations of praziquantel at this dosage in field populations of mallards were found to significantly reduce parasite loads (Reimink et al., 1995). This observed difference in drug efficacy may in part be related to the anatomical difference between the 2 anatid species. Unlike mallards, which have a longer digestive tract to accommodate a diet primarily consisting of plants and microorganisms, common mergansers are exclusively carnivorous and have a correspondingly short digestive tract. Typically, ingested material would spend less time within their alimentary canal, reducing the amount of time that praziquantel could be absorbed into the circulatory system. Although a change in administration method alone was not enough to effect a significant reduction in parasite load, an accompanying 5-fold increase in dosage did result in a significant reduction in avian parasite load ($\chi^2 = 19.16$, *P* < 0.003). It is unclear why this higher dose was needed in common mergansers.

Because avian schistosomes are the predominate causative agents for swimmer's itch (Cort, 1928a, 1928b), the results of the present study are certain to have implications for the control of this human dermatitis. Ever since 1939, when the State of Michigan initiated the first swimmer's itch control program (Michigan Department of Public Health, 1941), the most common approach is to treat recreational lakes with large quantities of copper sulfate, a proven molluscicide. This method of control targets the eradication of lymnaeid and physid snails from those lakes, thereby breaking the trematode's life cycle within its intermediate host.

Results from the present study suggest an alternative method of swimmer's itch control. By capturing and treating infected definitive hosts with praziquantel during the summer, it is possible to significantly reduce adult trematode populations within recreational lake ecosystems. Within a few years this would result in a profound lakewide reduction in the number of cercariae, the dermatitis-inducing life cycle stage of the parasite. We have indirect evidence from studies conducted on Glen Lake (Leelanau County, Michigan) suggesting that praziquantel can be used effectively in this manner. Two years after common mergansers were captured and treated with the drug, a significant reduction in both the prevalence of infected snails and in the intensity of schistosome infection in the birds was observed.

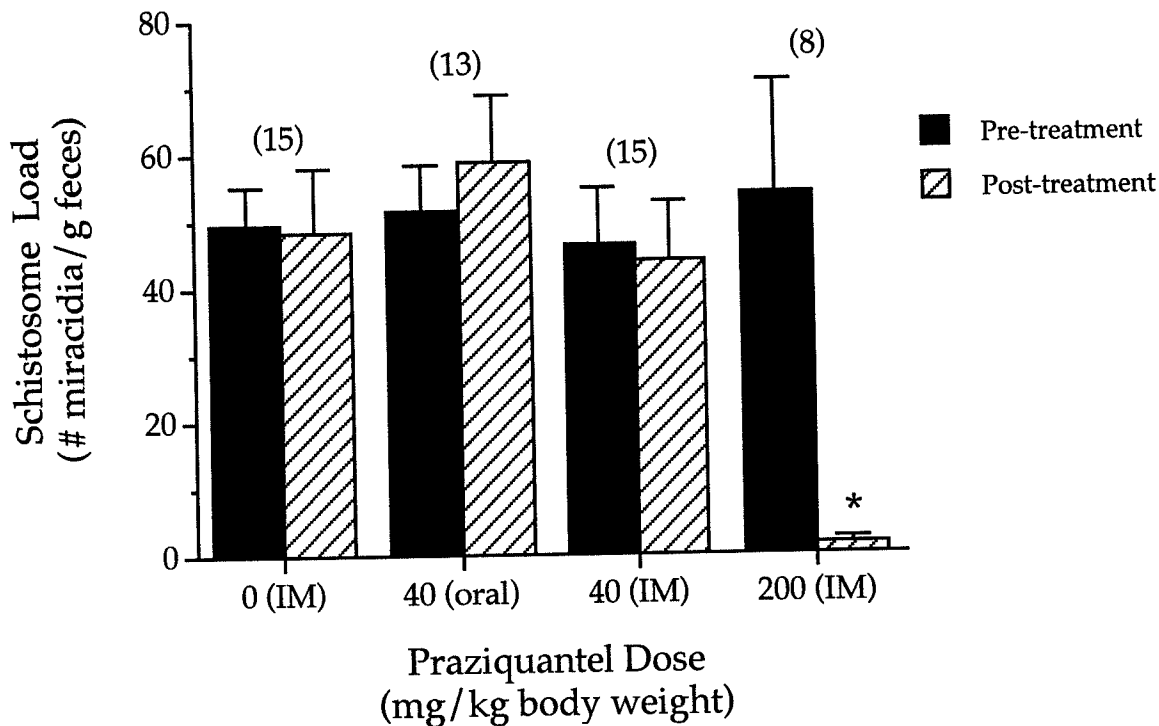


FIGURE 1. Effect of praziquantel on adult schistosome loads in naturally infected common mergansers. Each bar represents the mean + SEM. Numbers in parentheses represent sample sizes; asterisk indicates a statistical difference ($P < 0.005$) from the control dose (0 mg/kg).

Using praziquantel to control swimmer's itch has several advantages over copper sulfate. First, it requires treating significantly fewer potential host animals. A typical recreational lake will not support more than 50 common mergansers, whereas the same lake can easily maintain suitable snail populations numbering in the tens of thousands. When the difference in prevalence of schistosome infections between these 2 host species, e.g., 60–80% for common mergansers versus <1% for snails (Blankespoor and Reimink, 1991), is considered, treatment target efficacy, or the percentage of treated individuals that are actually infected, becomes a second advantage of praziquantel over copper sulfate.

A third advantage of praziquantel is that the drug is nontoxic to all but avian schistosomes and other flatworms species (common mergansers are released unharmed after treatment). By comparison, not only do copper sulfate applications eliminate snail populations in the treatment area, but they also indiscriminately kill a wide variety of other invertebrate and vertebrate species.

Another factor to consider in control programs is the environmental impact of the various options. Copper sulfate, an inorganic compound with application amounts that are typically measured in tons, precipitates in the form of copper carbonates and persists significantly longer in the environment than does praziquantel, an organic compound that is administered in very small quantities and metabolized by the treated individual within a few days (Groll, 1984). For this reason, it can be argued that copper sulfate poses a much greater threat to long-term ecological balance of recreational lakes.

Finally, due largely to this significant discrepancy in the amount needed for treatment, it can also be argued, albeit less

convincingly because of varying application costs, that using praziquantel to help control swimmer's itch would be a less expensive option when compared with copper sulfate.

Despite these advantages explained above, direct evidence documenting that praziquantel-based control methods result in a reduction in the occurrence of swimmer's itch remains lacking. With the medical and economical impact generated over the last decade by a steady increase in the annual number of reported cases of swimmer's itch, the need for a comprehensive assessment of the various swimmer's itch control options is more critical than ever before.

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