Water treatment for the removal of schistosome cercariae: a review and identification of research needs

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Introduction

Schistosomiasis

Schistosomiasis is a water-borne helminthic disease caused by parasitic worms. Infection occurs through contact with cercaria-infested freshwater. While treatment with praziquantel can have immediate beneficial effects, reinfection can occur rapidly if people are re-exposed to contaminated water.

Water treatment for schistosomiasis control seeks to eliminate viable cercariae from water, and hence cut schistosomiasis transmission.

Objective

Determine the effectiveness of water treatment processes at removing or inactivating schistosome cercariae in water as reported in the literature, and identify important gaps in knowledge.

Systematic Review Methodology

Searches four databases for any combination of water treatment and human schistosome cercariae search terms

- Web of Science, PubMed, British Library, Google Scholar
- Found 1100 studies from 1910 to present
- Worked through studies according to flowchart on right
- 67 studies about the effect of water treatment on human schistosome cercariae

Gaps in Knowledge

- Different methods are used to assess the effect of water treatment on cercariae (motility, infectivity or viability of cercariae), making it difficult to compare results.
- Lack in studies on S. japonicum and S. haematobium.
- Experiments should be conducted using natural water in addition to pure water, as the real water matrix constituent may affect the efficiency of water treatment processes.

Clorination: Studies conducted under controlled pH and temperature are needed. Many studies exclusively measured the chlorine dose, not the residual chlorine which is essential for calculating the CT value.

Filtration: The effect of sand grain size, bed depth and flow rate on cercariae filtration should be evaluated.

UV: Many studies lacked accurate UV measurements, and did not control temperature (heat emitted by UV lamps can affect experiments). The effectiveness of solar disinfection needs to be further examined.

Table 1: Effect of UV radiation on cercariae and worms

<table>
<thead>
<tr>
<th>Author</th>
<th>Species</th>
<th>UV dose (mJ/cm²)</th>
<th>Effect on cercariae</th>
<th>Effect on worm burden</th>
</tr>
</thead>
<tbody>
<tr>
<td>Krakower (1940)</td>
<td>S. mansoni</td>
<td>60 min sunlight</td>
<td>Died</td>
<td>No worms recovered</td>
</tr>
<tr>
<td>Ripper (1936)</td>
<td>S. mansoni</td>
<td>90 min sunlight</td>
<td>Died</td>
<td>No worms recovered</td>
</tr>
<tr>
<td>Rennage (1932)</td>
<td>S. mansoni</td>
<td>90</td>
<td>90% survival from cercaria to worm</td>
<td>No worms recovered</td>
</tr>
<tr>
<td>Okada (1948)</td>
<td>S. mansoni</td>
<td>90</td>
<td>90% survival from cercaria to worm</td>
<td>No worms recovered</td>
</tr>
<tr>
<td>Ito (1950, 1951)</td>
<td>S. japonicum</td>
<td>90</td>
<td>90% viability, survival rate of cercaria to worm in 60 min</td>
<td>No worms recovered</td>
</tr>
<tr>
<td>Nakamura (1950)</td>
<td>S. japonicum</td>
<td>90</td>
<td>90% viability, survival rate of cercaria to worm in 60 min</td>
<td>No worms recovered</td>
</tr>
</tbody>
</table>

Figure 1: Cercarial inactivation at various temperatures and times

Figure 2: Chlorine doses and contact times required to kill cercariae

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References