Helminths: An Introduction to Pathogenic Worms in Man

Introduction

Table 1 below summarizes Helminths and provides an overview of 18 different worms that create havoc with humans. This table is not by any means inclusive, but is representative of the major parasitic critters that are pathogenic to man.

<table>
<thead>
<tr>
<th>Platyhelminthes</th>
<th>Nemathelminthes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cestoda</td>
<td>Trematoda</td>
</tr>
<tr>
<td>Tapeworms</td>
<td>Flukes</td>
</tr>
</tbody>
</table>

Table 1. A summary of Helminths.

The classical method of identifying ova and parasites (O&P) is by examining fecal samples microscopically. Those samples may be examined by wet mounts of the fresh sample, wet mounts of the preserved specimen, wet mounts of concentrated specimen or by staining a fecal smear.

A wet mount is made by mixing a small amount of the fresh or preserved feces in normal saline. A drop of this suspension is applied to a microscope slide and a cover slip is positioned over the drop. Since this sample is to be examined under oil immersion, the cover slip must be sealed to the microscope slide. A mixture of paraffin and vaseline melted together and "painted" onto the edges of the cover slip serves this purpose.

Specimens may be concentrated, i.e., remove the garbage and collect the O&P, by one of two techniques. These techniques are summarized in Table 2.
<table>
<thead>
<tr>
<th>Technique</th>
<th>Pros</th>
<th>Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Formalin-Ether</td>
<td>Efficient in recovering most <em>helminth</em> eggs; moderately effective in recovering schistosome eggs.</td>
<td>Lose <em>H. nana</em> eggs; decreases the concentration of <em>G. lamblia</em> cysts; EXPLOSIVE!</td>
</tr>
</tbody>
</table>

O&P settle to bottom after centrifugation

<table>
<thead>
<tr>
<th>Technique</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Formalin-ZnSO$_4$</td>
<td></td>
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<tr>
<td>Flotation</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Comment</th>
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<tbody>
<tr>
<td>Clear up specimen; decreases distortion of parasites</td>
</tr>
</tbody>
</table>

Unsatisfactory for schistosome ova

<table>
<thead>
<tr>
<th>Technique</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>O&amp;P float to top of supernatant after centrifugation</td>
<td></td>
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</tbody>
</table>

Table 2. Summary of the two methods of obtaining O&P for microscopic exam.

Samples obtained by concentration methods are examined quickly under the microscope.

Table 3 summarizes one permanent staining technique for the microscopic visualization of O&P.

<table>
<thead>
<tr>
<th>Technique</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheatley Trichrome Stain</td>
<td>Destaining increases visualization of some O&amp;P</td>
</tr>
<tr>
<td>Trichrome Stain REACTIONS</td>
<td>Cytosol of cysts and trophozoites are blue-green with a purplish tinge; the nucleus, RBC and bacteria are red to purple red; yeasts are green and the background of the slides is green</td>
</tr>
</tbody>
</table>

Table 3. Summary of the Wheatley Trichrome O&P Stain method.

In any event, the one variable which remains constant is that to visualize O&P, one must know their appearance. Following the NCID’s format of life
cycle with micrographs, once again, below are two representative cestodes (tape worms):

Diphyllobothrium. latum

How they appear as adults is in your book – examples are also preserved in the lab.

The following are renderings of trematodes – the flukes. Life cycle format follows, directly:

http://www.dpd.cdc.gov/dpdx/HTML/ImageLibrary/Taeniasis_il.htm
The ova of the schistosomes are illustrated (and cited) below:

<table>
<thead>
<tr>
<th>S. mansoni</th>
<th>S. haematobium</th>
<th>S. japonicum</th>
</tr>
</thead>
</table>

The schistosomes are shaped differently: males short and stubby; females long and thin. This is because when they reproduce, the female slides inside...
the male’s coital groove. This groove serves as a receptacle for the female during copulation:

![Image of the male's coital groove](http://www.med.sc.edu:85/parasitology/schis-2.jpg -- Dr. Abdul Ghaffar; University of South Carolina)

Sketches/renderings of the appearances of the ova of the last three *Trematodes* from Table 1 are shown below:
Clonorchis sinensis

Embryonated eggs passed in feces.

Metacercariae in flesh or skin of fresh water fish are ingested by human host.

Free-swimming cercariae encyst in the skin or flesh of fresh water fish.

Eggs are ingested by the snail.

Miracidia, Sporocysts, Rediae, Cercariae

= Infective Stage

= Diagnostic Stage

Excyst in duodenum

Adults in biliary duct

http://www.dpd.cdc.gov/dpdx/HTML/ImageLibrary/Clonorchiasis_il.htm
Fasciola hepatica

http://www.dpd.cdc.gov/dpdx/HTML/ImageLibrary/Fascioliasis_il.htm

Next follows nematodes (round worms):
Ascaris lumbricoides

http://www.dpd.cdc.gov/dpdx/HTML/ImageLibrary/Ascariasis_il.htm
Enterobius vermicularis

The pin worm, *E. vermicularis*, is rather strange, as this parasite is difficult to visualize in a fecal preparation. The simplest manner in which to obtain a sample for microscopic examination is to perform a "Scotch Tap Prep". In essence, the "Scotch Tape Prep" works by removing O&P of *E. vermicularis* from the inner surfaces of the gluteal fold by clear Scotch tape. The two best times of the day to obtain good samples are about 2 hours after the patient has gone to bed and upon rising in the morning (before bath or bowel movement). It is also advisable to perform this sample collection on at least two consecutive days (in some cases three) at the same time of day.

CAUTION: Do NOT place the Scotch tape end of the tongue depressor IN or ON the anus -- this can irritate and/or damage the mucous membranes.

The sample is then returned to the lab where the slide is either immediately examined OR the tape is lifted (CAREFULLY: this is infectious) and one drop of toluene or 0.1N NaOH is placed on the slide, the tape reapplied, a cotton ball is run over the tape [and discarded] and the specimen is then examined. Toluene or NaOH helps to clear up the specimen so that ova, "egg shells" or parasites are more easily observed.

Necator americanus and/or Ancylostoma duodenale

Strongyloides stercoralis

1. Eggs deposited in intestinal mucosa, hatch, and migrate to lumen.
2. Development into free-living adult worms.
3. Eggs are produced by fertilized female worms.
4. Rabditiform larvae hatch from embryonated eggs.
5. The rabditiform larvae develop into infective filariform.
6. Infective filariform larvae penetrate the intact skin initiating the infection.
7. The filariform larvae enter the circulatory system, are transported to the lungs, and penetrate the alveolar spaces. They are carried to the trachea and pharynx, swallowed, and reach the small intestine where they become adults.
8. Adult female worm in the intestine.
9. Eggs deposited in intestinal mucosa, hatch, and migrate to lumen.
10. Autoinfection: Rabditiform larvae in large intestine, become filariform larvae, penetrate intestinal mucosa or perianal skin, and follow the normal infective cycle.

Trichinella spiralis

1 = Infective Stage
△ = Diagnostic Stage

http://www.dpd.cdc.gov/dpdx/HTML/ImageLibrary/Trichinellosis_il.htm
Trichuris trichiura

1. Unembryonated eggs passed in feces.
2. 2-cell stage
3. Advanced cleavage
4. Embryonated eggs are ingested.
5. Larvae hatch in small intestine
6. Adults in cecum

http://www.dpd.cdc.gov/dpx/HTML/ImageLibrary/Trichuriasis_il.htm
Materials and Methods

Materials

<table>
<thead>
<tr>
<th>Prepared slides of the following</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>$T. pisiformis$</td>
<td>$Taenia ova$</td>
<td>$S. japonicum$</td>
</tr>
<tr>
<td>$F. hepatica$</td>
<td>$A. lumbricoides$</td>
<td>$T. trichiura$</td>
</tr>
<tr>
<td>$T. spiralis$</td>
<td>$E. vermicularis$</td>
<td>$C. sinensis$</td>
</tr>
<tr>
<td>$D. latum$</td>
<td></td>
<td>$N. americanus$</td>
</tr>
</tbody>
</table>

The following equipment/supplies

| Microscope | Immersion oil | Lens paper |

Methods

With the exception of the slide of $S. japonicum$, observe each slide under oil immersion. Draw in the spaces below that which you see/saw. In the case of the slide of $S. japonicum$, experiment with the 10X and 20X objectives to observe its oral and ventral suckers. Draw in the spaces below that which you see/saw.
REFERENCES


