Introduction of Cestodes (Tapeworms)

Phylum Platyhelminthes
Class Cestoda
Order Pseudophyllidea
Order Cyclophyllidea

Morphology

• Flat, segmented body with various length (several mm ~ several meters)

• 3 regions of worm body:
  – Scolex: suckers, hooklets, grooves
  – Neck: germinal portion
  – Strobila: immature, mature, gravid proglottids (segments)
• Monoecious (each segment): reproductive system highly developed
• Digestive system degenerated
• All species are parasitic

Medically important species of cestode.

a. *Diphyllobothrium latum* has a *SCOLEX* with elongated, slit-like attachment organs  
   Fish tape worm

b. *Taenia saginata* has four muscular *SUCKERS*  
   Beef tape worm.

c. *Taenia solium* has similar muscular *SUCKERS*  
   Pork tape worm.

d. *Hymenolepis nana*  
   Dwarf tape worm.

e. *Echinococcus granulosus*  
   Dog tape worm.
TAPEWORM LIFECYCLE:

The DEFINITIVE HOST ingests the larval form. Worms mature from larval forms in the intestine of definitive host. The definitive host harbors ADULT WORMS in the intestine. EGGS are passed in the stool.

Eggs are ingested by the INTERMEDIATE HOST. LARVAE develop from eggs in the intermediate host and penetrate the host intestinal mucosa.

Larvae develop into ENCYSTED FORMS in tissues of intermediate host. The CYSTICERCUS is the encysted form of the Taenia species. The HYDATID is the encysted form of the Echinococcus.

NOTE: Diphyllobothrium latum has two intermediate hosts.
**Taenia solium**  
Pork tapeworm / Hook tapeworm  

**Taenia saginata**  
Beef tapeworm / Hookless tapeworm

---

**Morphology**

<table>
<thead>
<tr>
<th></th>
<th><em>T.saginata</em></th>
<th><em>T.solium</em></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Size</strong></td>
<td>4-8 m</td>
<td>2-4 m</td>
</tr>
<tr>
<td><strong>Scolex</strong></td>
<td>4 suckers</td>
<td>4 suckers, rostellum &amp; hooklets</td>
</tr>
<tr>
<td>Mature proglottid</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ovary</td>
<td>2 lobes</td>
<td>3 lobes</td>
</tr>
<tr>
<td><strong>Testes</strong></td>
<td>300-400</td>
<td>150-200</td>
</tr>
<tr>
<td>Gravid proglottid: Uterine branches</td>
<td>15-30</td>
<td>7-12</td>
</tr>
</tbody>
</table>
The chain of proglottids is called the strobila, and may be composed of over 1,000 proglottids. *T. saginata* may measure 9 m, whereas *T. solium* may reach 6 m.

*Taenia spp. adult worm*

The beef tapeworm (Living specimen)
The scolex of *T. solium*

The scolex of *T. saginata*
*Taenia saginata*, fresh specimen

*Gravid proglottid of *T. solium*
Gravid proglottid of *T. saginata*

- Larva
  
  *Cysticercus bovis*
  
  *Cysticercus cellulosae*
  
  – Ovoid, cystic, size = a bean
  
  – Invaginated scolex and neck
**T.solium**: cysticercus cellulosae with invaginated scolex

- **Egg**
  - Indistinguishable in two species
  - Ovoid
  - < Ascarid egg
  - Radically striated embryophore
  - Content: hexocanth embryo (oncosphere: 6 hooklets)
**Taenia spp. egg**

Can not differentiate *T. saginata* from *T. solium*
Life Cycle

- Definitive host
  - Human being; No reservoir host
- Discharged stage
  - Eggs or gravid proglottids in feces

Life cycle of *Taenia saginata*
Life cycle of *Taenia solium*

<table>
<thead>
<tr>
<th></th>
<th><em>T.saginata</em></th>
<th><em>T.solium</em></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>D.H</strong></td>
<td>Human</td>
<td>Human</td>
</tr>
<tr>
<td><strong>LH</strong></td>
<td>Cattle</td>
<td>Swine</td>
</tr>
<tr>
<td><strong>Habitation</strong></td>
<td>Small intestine</td>
<td>Small intestine</td>
</tr>
<tr>
<td><strong>Infective stage</strong></td>
<td>Cysticercus bovis</td>
<td>Cysticercus Cellulosae</td>
</tr>
<tr>
<td><strong>Disease</strong></td>
<td>Taeniasis</td>
<td>Taeniasis</td>
</tr>
</tbody>
</table>
Pathogenesis

• **Taeniasis** (Infected by eating cysticerus; Pathogenic factor: adult worm)
  – Deprivation of nutrition
  – Disfunction of the intestine: vomiting or diarrhea
  – Allergic reactions
  – Appendicitis
  – Obstructions of the intestine

• **Cysticercosis** (Intrinsic or extrinsic auto-infection; Cross infection due to *T. solium* egg only; Pathogenic factor: cysticercus cellulosae)
  – Symptoms vary with site & intensity of infection
  – Clinical aspects: headache, dizziness, epilepsy, blurred vision, subcutaneous nodule etc
Diagnosis

• Taeniasis
  – Anal swab: to find egg at perianal region
  – Fecal exam: to find segment (species identification)

• Cysticercosis
  – Biopsy (subcutaneous nodule)
  – X-ray/CT/MRI: cerebral cysticercosis
  – Ophthalmoscopy: ophthalmic cysticercosis

Epidemiology

• Distribution
  – Cosmopolitan
  – In china: mainly in minority regions
• Epidemic factors
  – Egg or gravid proglottid contamination of grass and soil
  – Method of raising domestic animals
  – Unhygienic dining habit of eating raw or undercooked meat

Control

• Treatment
  – Paziquantel
  – Areca nut + pumpkin seed + purge
• Scientific cattle and pig raising
• Avoid to consume raw meat
• Meat inspection
Echinococcus granulosus

Morphology

• Adult worm
  – 3-6 mm long with 4 segments
  – Scolex & cervical portion (2 rows of 28-40 hooklets and 4 suckers)
  – Immature, mature, gravid segments

• Egg
  – Similar to the Taenia egg
• Hydatid cyst
  – Round & cystic
  – Cyst wall: laminated layer, germinal layer
  – Contents: cystic fluid, brood capsules, protoscolex, daughter & grand daughter cyst, (hydatic sand)
• Hydatid sand
  – The protoscoleces generally settle down at the bottom of the cyst and are known as hydatid sand.
Protoscoleces

Hydatid sand
Life Cycle

- **Adult worm**
  - In the small intestine of the dog and other carnivores
- **Larva (hydatid cyst)**
  - In the tissue of human being, sheep, horse, pig, etc.
• Infective stage: egg
• Infective route: mouth
• Location: liver, lung, brain, eye, kidney, muscles, bone and heart
• Zoonotic parasite

Pathogenesis

• ‘Echinococcosis’, ‘Hydatidosis’
  – Depend on the location and the number of hydatid cysts
• Pressure: liver, pulmonary, etc
• Allergy: anaphylactic shock
• Regeneration: secondary infection
Epidemiology

• Distribution
  – Forest type (human are seldom involved)
    • Wolf-moose/reindeer
    • Dingo-wallaby
  – Animal raising type (human are involved)
    • Dog-sheep/cattle/pig

• Endemic factors
  – High resistant egg
  – Intimate contact between dog, animals and man in local district
  – Contamination of the feces by infected dogs
  – Improper the viscera disposition
Diagnosis

- Physical (hepatic hypertrophy)
- History of residence in endemic area
- X-ray/Ultrasonography
- Immunological means
- Biopsy and puncture are forbidden unless during operation

Treatment and Control

- Surgical removal of the cyst
- Long-term Mebendazole therapy
  - 40 mg/kg/day × 1-6 months
- Personal protection
- Reasonable disposition of the viscera from infected animals
- Treatment of sheep dogs periodically
LIFE CYCLE of *ECHINOCoccus GRANULOSUS*

- **Evaginated scolex into intestine**
- **Scolex from cyst**
- **Dog**
  - Hydatid cyst
  - Embryonated egg in faeces (infective stage)
- **Man**
  - Penetration of the intestinal wall, circulation
  - Hydatid cyst
  - Circohemosphere hatches