CLASS
CESTOIDEA
SUBCLASS CESTODA

Characters:
* Flattened dorsoventrally
* Ribbon-like (Tapeworms).
* Has no body cavity.
* Alimentary canal absent.

*Segmented into scolex, neck and strobila.

**Scolex** (head): carry organs of fixation in the form of suckers or grooves (bothria). The scolex may carry a terminal sometimes retractile protuberance called the rostellum. The rostellum is usually armed with hooks.

**Neck**: actively dividing part forming the strobila.

**Strobila** (segments or proglottids): a chain of progressively developing segments. The anterior most segments in which the reproductive organs are not fully developed are called immature segments. These gradually merge into mature segments in which the organs are fully developed and functioning, and these in turn into gravid segments having a uterus full of eggs.

*Excretory system*: Flame cells and collecting tubules drain into ventral and dorsal longitudinal excretory canals extending along the lateral margins of the proglottids and discharge at the posterior end.

*Genital system*: Cestodes are hermaphrodites. Each mature segment contains male and female genital systems. Cross as well as auto-copulation takes place. Male organs develop before female ones.
Subclass CESTODA is divided into two orders:

1- ORDER PSEUDOPHYLLIDEA
2- ORDER CYCLOPHYLLIDEA

<table>
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<tr>
<th></th>
<th>PSEUDOPHYLLIDEA</th>
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<tbody>
<tr>
<td>Scolex</td>
<td>Elongated</td>
<td>Globular</td>
</tr>
<tr>
<td>Organs of attachment</td>
<td>Bothria</td>
<td>Suckers and hooks</td>
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<tr>
<td>Mature segment</td>
<td></td>
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<tr>
<td>Genital pore</td>
<td>Ventral</td>
<td>Lateral</td>
</tr>
<tr>
<td>Uterus</td>
<td>Open ventrally</td>
<td>Blind</td>
</tr>
<tr>
<td>Vitellaria</td>
<td>Scattered</td>
<td>Single mass</td>
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<tr>
<td>Gravid segment</td>
<td>Absent</td>
<td>Present</td>
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<tr>
<td>Eggs</td>
<td>Operculated</td>
<td>Non-operculated</td>
</tr>
<tr>
<td></td>
<td>Immature</td>
<td>Mature</td>
</tr>
<tr>
<td></td>
<td>Need water for develop-</td>
<td>Do not need water</td>
</tr>
<tr>
<td></td>
<td>ment</td>
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<tr>
<td>Intermediate hosts</td>
<td>Two hosts</td>
<td>One host</td>
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<td>Solid larvae:</td>
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<tr>
<td></td>
<td>1- Procercoid</td>
<td>1- Cysticerкус</td>
</tr>
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<td></td>
<td>2- Plerocercoid</td>
<td>2- Cysticerкус</td>
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<tr>
<td></td>
<td></td>
<td>3- Hydatid</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4- Coenurus</td>
</tr>
<tr>
<td>Members</td>
<td>Diphyllobothrium latum</td>
<td>Taenia saginata</td>
</tr>
<tr>
<td></td>
<td>Diphyllobothrium mansoni</td>
<td>Taenia solium</td>
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<tr>
<td></td>
<td></td>
<td>Hypenolepis nana</td>
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<tr>
<td></td>
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<td>Hymenolepis diminuta</td>
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<td>Dipylidium caninum</td>
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<tr>
<td></td>
<td></td>
<td>Echinococcus granulosus</td>
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<tr>
<td></td>
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<td>Multiceps multiceps</td>
</tr>
</tbody>
</table>
Man may be infected with the adult tapeworms (Definitive host) or their larval stages (Intermediate host):

**Human infection with adult cestodes (Intestinal cestodes):**
- Diphyllobothrium latum
- Taenia saginata
- Taenia solium
- Hymenolepis nana
- Hymenolepis diminuta
- Dipylidium caninum

**Human infection with larval cestodes (Extraintestinal cestodes):**
- Sparganosis.
- Cysticercosis.
- Hydatid disease.
- Coenurosis.

**INTESTINAL CESTODES**
**DIPHYLOBOTHRIUM LATUM**
(Broad tapeworm, Pish tapeworm)

**Disease:** Diphyllobothriasis

**Distribution:** Lake regions in Europe, Baltic countries, some foci in America and Russia.

**Morphology:**

**Adult:**
- Size: 3-10 m.
- Scolex: elongated almond-shaped (about 2.5x1 mm) with 2 elongated dorsal and ventral grooves (bothria).
- Mature segments: broader than long (about 3x15 mm) containing the male and female genital system:
  - **The male system** comprises numerous testes distributed in the dorsal part of the segment from which vasa efferentia arise and lead to the vas deferens. This proceeds anteriorly, dilates in a seminal vesicle and terminates in a cirrus which opens in the common genital pore on the ventral side.
The female system

comprises a bilobed ovary lying posteriorly in the segment. This leads into the oviduct which open in the ootype (surrounded by shell gland). The vitelline glands are distributed in the ventral part of the segment. From the ootype arise the uterus and vagina. The uterus proceeds anteriorly as a convoluted tube (rosette-shaped) to open posterior to the common genital pore, while the vagina opens in the common genital pore posterior to the male opening.

Egg:
Size: about 70 x 45 u
Shape: oval. operculated. thick-shelled.
Colour : yellowish-brown
Contents: immature ovum.

Coracidium: Spherical 6-hooked embryo (Onchosphere) enclosed in a ciliated embryophore.

Procercoid: Solid elongated organism about 0.5 mm., with a spherical caudal end having 6 hooks.

Plerocercoid: solid elongated organism about 1-2 cm., with invagi-nated anterior end. The body is striated but not segmented.

Life cycle:
1-The adult lives in the small intestine of man (Definitive host) and fish-eating animals (Reservoir hosts).
2-Immature eggs (Diagnostic stage) pass in faeces (a full worm lays about one million eggs daily).
3-In fresh water, the embryo (Coracidium) develops in about 2 weeks, hatches and swims in water.
4-If the coracidium is swallowed by the first intermediate host, a crustacean copepod (Cyclops or Diaptomus = water flea), it loses its ciliated embryophore and penetrates the intestinal wall reaching the body cavity to become a procercoid larva in about 2 weeks.
5- When the infected cyclops is swallowed by the second intermediate host, fresh water fish e.g. salmon, it is digested and the proceroid larva liberated penetrates the intestinal wall reaching different tissues and muscles where it becomes a plerocercoid larva in about 2 weeks.

6- The final host is infected by ingestion of undercooked or smoked fish containing the plerocercoid larva (the infective stage). This attaches to the intestinal wall and grows to maturity.

**Pathogenicity:**

1- Intestinal disturbances as hunger pains, dyspepsia, colic and diarrhoea.
2- Large number of worms may produce intestinal obstruction.
3- Worms attached high in the duodenum or jejunum lead to pernicious macrocytic anaemia due to absorption of vitamin B12. Neurologic manifestations are common and may occur in absence of haematologic findings.

**Diagnosis:** finding eggs in faeces.

**Treatment:**

1- Niclosamide (Yomesan): 4 tablets (2 gm) chewed thoroughly and swallowed with a small amount of water in a single dose on empty stomach.
2- Atebrine: 4 doses of 200 mg (2 tablets), 10 minutes apart followed by a saline purge after 2 hours.
3- Mebendazole (Vermox): 300 mg (3 tablets) twice daily for 3 days.
4- Praziquantel (Biltricide, Distocide): 10 mg/kg as a single oral dose.
5- Paromomycin (Humatin): 75 mg/kg single oral dose with maximum of 4 gm (one gm every 15 minutes for 4 doses).
6- In presence of macrocytic anaemia, vitamin B12 should be given par enterally.
Prevention and control:
1- Proper cooking of fish (at least 56 C for 5 mm), freezing at -10 C for 72 hours or prolonged salting.
2- Abstinence from defaecation or sewage disposal in water.

TAENIA SAGINATA
(Beef tapeworm; Bald tapeworm)

Disease: Taeniasis saginata.

Distribution: Cosmopolitan.

Morphology:
1- Adult:
   size: 4-6 nru
   Scolex: globular (2 mm in d.) with 4 suckers but without rostellum or hooks.
   Mature segments: squarish or slightly broader than long (about 1x1 cm) containing the genital organs which open by irregularly alternate lateral genital pores.

   The male system comprises numerous testes (about 400) giving vasa efferentia, then the vas deferens proceeds laterally to open by the cirrus in the common genital pore.

   The female system comprises a bilobed ovary lying posteriorly in the segment with a compact vitelline gland behind it. From the ootype arise the uterus and vagina. The uterus proceeds anteriorly and ends blindly, while the vagina proceeds laterally posterior to the vas deferens to open posterior to the male opening.

   Gravid segments: longer than broad (about 20x7mm) with the uterus having 15-30 (18) lateral branches on each side.

2- Egg:
   Size: 30-40 u in d.
   Shape: spheroid.
Radially striated embryophore. (in the uterus the egg is covered by a membraneous shell, with 2 polar filaments, which is lost during disintegration of the segment).

Colour: yellowish-brown.
Contents: hexacanth embryo (onchosphere).

3- **Cysticercus bovis** (bladder worm): a bladder-like structure lined with a germinal layer enclosing a cavity containing fluid. From the germinal layer develops an invaginated scolex with 4 suckers. It measures about 1-2 cm.

**Life cycle:**
1- The adult lives in the upper part of the small intestine of man.
2- Mature eggs and gravid segments pass in the faeces. Gravid segments are detached separately and disintegrate liberating eggs. Sometimes these segments creep out of the anus by their own activity,
3- When the eggs or gravid segments are ingested by the intermediate host (cattle) the onchosphere hatches, penetrates through the intestinal wall into the lymphatics or blood vessels to the right side of the heart to the lung to the systemic circulation where it is distributed everywhere specially in active muscles, brain, bones, etc... There it develops into Cysticercus bovis in about 12 weeks and remains viable for about one year. In muscles, cysticerci become surrounded by fibrous capsules formed by the host, which may be calcified later on.
4- The final host (man) is infected by ingestion of undercooked beef containing viable Cysticercous bovis (the infective stage). In the intestine, the scolex is evaginated, attaches to the mucosa and the worm develops to maturity in about 10 weeks,

**Pathogenicity:**
1- Intestinal disturbances as hunger pains, indigestion, abdominal discomfort, diarrhoea or constipation.
2- Loss of weight.
3- Intestinal obstruction.
4- Segments of *Taenia saginata* migrating out of the anus cause worry and anxiety.
# TAENIA SOLIUM
*(Pork tapeworm)*

The differences between *T. saginata* and *T. solium*

<table>
<thead>
<tr>
<th></th>
<th>TAENIA SAGINATA</th>
<th>TAENIA SOLIUM</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Disease</strong></td>
<td>Taeniasis saginata</td>
<td>Taeniasis solium</td>
</tr>
<tr>
<td><strong>Distribution</strong></td>
<td>Cosmopolitan</td>
<td>Cosmopolitan where pigs are eaten, not in Islamic countries</td>
</tr>
<tr>
<td><strong>Adult</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Size</strong></td>
<td>4-6 m.</td>
<td>2-4 m.</td>
</tr>
<tr>
<td><strong>Scolex</strong></td>
<td>2 mm in d.</td>
<td>1 mm in d.</td>
</tr>
<tr>
<td></td>
<td>no rostellum or hooks.</td>
<td>rostellum with double crown (circle) of alternate large and small hooks (short handle, long blade and a guard).</td>
</tr>
<tr>
<td><strong>Mature segment</strong></td>
<td>Testes more numerous (400).</td>
<td>Testes fewer (200).</td>
</tr>
<tr>
<td></td>
<td>Ovary bilobed.</td>
<td>Ovary trilobed.</td>
</tr>
<tr>
<td></td>
<td>Vaginal opening with sphincter.</td>
<td>Without.</td>
</tr>
<tr>
<td><strong>Gravid segment</strong></td>
<td>20 x 7 mm</td>
<td>12 x 6 mm</td>
</tr>
<tr>
<td></td>
<td>Uterus with 15-30 (18) lateral branches.</td>
<td>7-12 (9) lateral branches</td>
</tr>
<tr>
<td></td>
<td>Segments detach singly (creep out without defaecation)</td>
<td>Segments detach in groups of about five.</td>
</tr>
<tr>
<td><strong>Egg</strong></td>
<td>Similar (not infective to man)</td>
<td>Similar (infective to man —&gt; cysticercosis).</td>
</tr>
<tr>
<td><strong>Definitive host</strong></td>
<td>Man</td>
<td>Man</td>
</tr>
<tr>
<td><strong>Intermediate host</strong></td>
<td>Cattle (not man).</td>
<td>Pig (and man).</td>
</tr>
<tr>
<td><strong>Larval stage</strong></td>
<td>Cysticercus bovis (scolex without hooks)</td>
<td>Cysticercus cellulosae (scolex with hooks).</td>
</tr>
<tr>
<td><strong>Human infection</strong></td>
<td>Ingestion of undercooked beef —&gt; taeniasis.</td>
<td>1) Ingestion of undercooked pork —&gt; taeniasis.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2) Ingestion of eggs —&gt; cysticercosis.</td>
</tr>
</tbody>
</table>
**Diagnosis:**
1- Finding eggs in the faeces, and may be in perianal scraping using a swab.
2- Searching for gravid proglottids in the faeces to differentiate *T. saginata* from *T. solium*. If not found, give a saline purge (segments pressed between 2 slides).

**Treatment:**
1- Same drugs used in *D. latum*.
2- Precautions in case of *T. solium*:
   (a) Niclosamide and paromomycin because they disintegrate the segments releasing viable eggs which may cause cysticercosis, a saline purge is given one hour after treatment.
   (b) With atebrine treatment, give a drug which prevents vomiting one hour before treatment.

**Prevention and Control:**
1- of adult worms:
   (a) Prevention of contamination of areas where cattle and pigs graze with human faeces.
   (b) Inspection of beef and pork for cysticerci at slaughter houses. Infected carcasses are condemned.
   (c) Thorough cooking of meat (at least 56°C for 5 mn) or freezing at -10°C for 5 to 10 days. Avoid suspected underdone meat (grilled or pickled).

2- of cysticercosis; where *T. solium* is prevalent:
   (a) Human faeces should not be used as manure.
   (b) Avoid eating raw vegetables.
   (c) Prompt treatment of infected persons to eliminate the danger of auto infection with cysticerci.
   (d) Infected persons should not take emetics or nauseating drugs.
HYMENOLEPIS NANA
(Dwarf tapeworm)

**Disease:** Hymenolepiasis nana.

**Distribution:** Cosmopolitan.

**Morphology:** (A morphologically indistinguishable species, *H. Fraterna* is found in rats and mice).

1- **Ault:**
   
   **Size:** 1-3 cm (the smallest tapeworm of man).
   
   **Scolex:** Globular about 0.3 mm in d.
   
   **4 suckers.**
   
   a retractile rostellum with a crown of hooks (long handle, short blade and a guard).
   
   **Mature segments:** broader than long (0.5 x 0.15 mm).
   
   **Male genitals:** 3 testes, one on the side of the genital pore and two on the aporal side.
   
   **Female genitals:** as in *Taenia*. Genital pores are unilateral and always open to one side.
   
   **Gravid segments:** broader than long occupied by a sac-like uterus full of eggs.

2- **Egg:**

   **Size:** 30-50 u in d.
   
   **Shape:** spheroid with 2 envelopes:
   
   **Outer egg shell.**
   
   **Inner embryophore** with two polar thickenings from each arises 4-8 filaments.
   
   **Colour:** translucent.
   
   **Contents:** mature hexacanth embryo.

3- **Cysticercoid:**

   a bladder-like structure similar to cysticercus but the head is withdrawn in upright position and not invaginated. It has a tail-like appendage (Cercocystic cysticercoid).
**Life cycle:**
1- The adult lives in the small intestine of man and rodents (rats 'and mice).

2- Mature eggs pass in faeces and are immediately infective (the infective stage). No intermediate host is required.

3- When the final host swallows the egg in food, drink or by autoinfection, the onchosphere hatches in the small intestine, penetrates into the submucosa to become a cysticercoid. After about one week it returns to the lumen and develops into an adult worm. So man acts as definitive as well as intermediate host.

4- Eggs appear in faeces about two weeks after infection.

5- Internal autoinfection could also occur, the eggs hatch in the intestine before passing in the faeces.

6- Also development may take place in an intermediate host if the egg is swallowed by flea larva (or other insects as flour insects, beetles and cockroaches). The onchosphere liberates in the intestine of the insect, penetrates into the body cavity where it develops into a cysticercoid. The cysticercoid persists through the metamorphosis of the larva into adult flea. When such flea is ingested with food the cysticercoid is liberated and develops into adult.

**Pathogenicity:**
1- In light infections, usually there are no manifestations,

2- In heavy infections, ulcerations of the mucosa lead to enteritis. There may be abdominal discomfort, colic and diarrhoea with passage of mucus.

3- Some patients specially children suffer from dizziness and may be convolution, attributed to a neurotoxic product of the worms.

**Diagnosis:**
Finding eggs in faeces.

**Treatment:**
1- Niclosamide (Yomesan) 4 tablets (2 gm) chewed thoroughly in a single dose daily for 5-7 consecutive days. Treatment is prolonged or repeated in 3 weeks to kill worms that emerge from cysticercoids in the submucosa.

2- Praziquantel: a single oral dose of 15 mg/kg after breakfast.

3- Other antitraenial drugs may be used.
Prevention and Control:
1- Personal cleanliness (to avoid autoinfection).
2- Treatment of infected persons (treatment is prolonged or repeated).
3- Rodent control.

**HYMOLEPIS DIMINUTA**
(Rat tape worm)
The differences between *H. nana* and *H. diminuta*.

<table>
<thead>
<tr>
<th></th>
<th>HYMOLEPIS NANA</th>
<th>HYMOLEPIS DIMINUTA</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Distribution</strong></td>
<td>Comopolitan</td>
<td>Cosmopolitan</td>
</tr>
<tr>
<td><strong>Adult</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Size</td>
<td>1-3 cm.</td>
<td>30-60 cm.</td>
</tr>
<tr>
<td>Scolex</td>
<td>Rostellum with hooks</td>
<td>Rostellum without hooks</td>
</tr>
<tr>
<td>Mature segment and</td>
<td>Similar but smaller (0.5 x 0.15 mm)</td>
<td>Similar but bigger (4 x 0.8 mm)</td>
</tr>
<tr>
<td>Gravid segment</td>
<td>Testes and ovary close together in the middle of the mature segment</td>
<td>Two aporal testes and one poral testis with the ovary in between</td>
</tr>
<tr>
<td><strong>Egg</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Size</td>
<td>30-50 µ in d.</td>
<td>60-70 µ in d.</td>
</tr>
<tr>
<td>Shape</td>
<td>Polar filaments</td>
<td>Absent</td>
</tr>
<tr>
<td>Colour</td>
<td>Translucent</td>
<td>Yellowish</td>
</tr>
<tr>
<td>Contents</td>
<td>Onchosphere</td>
<td>Onchosphere</td>
</tr>
<tr>
<td><strong>Definitive host</strong></td>
<td>Man (rats, mice)</td>
<td>Rats, mice (rarely man)</td>
</tr>
<tr>
<td><strong>Intermediate host</strong></td>
<td>Optional</td>
<td>Obligatory (Rat flea and other insects as beetles and cockroaches).</td>
</tr>
<tr>
<td><strong>Larval stage</strong></td>
<td>Cysticercoid</td>
<td>Cysticercoid</td>
</tr>
<tr>
<td>(infective stage)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Human infection</strong></td>
<td>1) Direct (ingestion of eggs, autoinfection)</td>
<td>Ingestion of fleas and insects containing cysticercoid.</td>
</tr>
<tr>
<td></td>
<td>2) Indirect (ingestion of fleas and insects containing cysticercoid).</td>
<td></td>
</tr>
</tbody>
</table>
**Pathogenicity:** similar to *H. nana.*

**Diagnosis:** finding eggs in the faeces.

**Treatment:** antitaenial drugs.

**Prevention and control:**
- Care to avoid ingesting ectoparasites of rodents and other insects of flour and cereals.
- Rodent control.

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**DIPYLIDIMUM CANINUM**

*(Dog tapeworm)*

**Disease:** Dipyllidiasis.

**Distribution:** Cosmopolitan.

**Morphology:**

1- **Adult:**
   - Size: 20-60 cm. (Strobila appear beaded).
   - Scolex: about 0.5 mm in d.
     - 4 suckers.
     - A retractile rostellum with several rows of hooks (1-7).
     - Hooks are rose-thorn shaped.
   - Mature segments: longer than broad (12 x 4mm), cucumber-seed like containing two sets of genital organs with a genital pore on each lateral margin.
   - Gravid segments: similar to mature segments. The uterus divided into packets (egg capsules) each containing 5-15 eggs.

2- **Egg:**
   - Size: about 40 u in d.
   - Shape: spheroid with 2 envelopes separated by a hyaline layer.
   - Colour: yellowish-brown.
   - Contents: Onchosphere.

3- **Cysticercoid:** similar to that of nana or diminuta but without a tail appendage (Cryptocystic cysticercoid).
**Life cycle:**

1- The adult lives in the small intestine of dogs, cats and occasionally man.
2- Gravid proglottids or egg capsules pass in the faeces.
3- When swallowed by the intermediate host, Dog flea larva (and other insects) the onchosphere becomes a cysticercoid larva in the body cavity.
4- The final host is infected on ingestion of such an insect containing the cysticercoid larva (the infective stage).

**Pathogenicity:** usually symptomless.

**Diagnosis:** finding gravid segments or egg capsules in the faeces.

**Treatment:** antitaenial drugs.

**Prevention and control:**
1- Household pets should periodically be given anthelmintic treatment and insecticidal dusting to kill fleas.
2- Avoid fondling dogs and cats (accidental ingestion of infected fleas).

**EXTRA INTESTINAL LARVAL CESTODES**

The tapeworms that infect man in their larval stages include:

1- Sparganum or plerocercoid larva of *Diphyllobothrium mansoni* and other species (sparganosis)

2- Cysticer cus of *Taenia solium* (cysticercosis).

3- Hydatid cyst of *Echinococcus granulosus* and *E. multiloculavis* (Hydatidosis).

4- Coenurus cyst of *Multiceps multiceps* and other species (coenurosis).

5- Cysticercoid larva of *Hymenolepis nana*.
SPARGANOSIS

**Definition:** Infection of human tissues by the plerocercoid larva of *Diphyllobothrium mansoni* (Sparganum mansoni) or another plerocercoid larva (Sparganum proliferum), its adult worm and life cycle are unknown. This is irregular and has the tendency to multiply by budding giving lateral branches.

**Distribution:** mostly in the Far East.

**Life cycle of Diphyllobothrium mansoni:**
1- The adult lives in the small intestine of dogs and cats.
2- Eggs pass in the faeces of the host.
3- The first intermediate host is *Cyclops* containing the procercoid larva.
4- The second intermediate host is a frog, snake, bird or mammal containing the plerocercoid larva (Sparganum).

**Mode of human infection:**
1- Swallowing *Cyclops* (in water) containing the procercoid larva.
2- Eating raw or undercooked flesh of the second intermediate host containing the plerocercoid larva.
3- Applying infected flesh of such animals as a foment or poultice to wounds or inflamed tissues specially the eye, the sparganum migrates to the tissues.

**Pathogenicity:**
1- According to the tissue invaded, e.g. ocular infection produces painful oedematous conjunctivitis.
2- There is local inflammation and oedema.
3- The patient suffers from pain, fever and eosinophilia,
4- Death of the larva causes intense local reaction.

**Diagnosis:** finding the larva in the lesion.

**Treatment:** surgical removal.

**Prevention and control:**
1- In endemic areas water is boiled or filtered.
2- Thorough cooking of the flesh of suspected intermediate hosts.
3- Avoid using the flesh of intermediate hosts as poultice.
**Definition:** Infection of human tissues by Cysticercus cellulosae, the larval stage of *Taenia solium*

**Mode of infection:** man acquires infection on ingestion of the egg of *Taenia solium* (the infective stage) by one of the following ways:
1- Ingestion of food or water contaminated by infected human faeces.
2- External autoinfection: hand to mouth infection in a person harbouring the adult worm.
3- Internal autoinfection: regurgitation of eggs or gravid segments into the stomach by reverse peristalsis. On returning again to the intestine, eggs hatch.

**Pathogenicity:**
1- The cyst produces a foreign body inflammatory reaction which usually ends in fibrosis and calcification.
2- Manifestations depend upon the tissue invaded and the number of cysticerci.
3- The commonest sites are subcutaneous tissues, muscles, viscera, brain and orbit.
4- There may be muscle pains, mild fever and eosinophilia.

**Diagnosis:**
1- Biopsy.
2- X-ray may show calcifications later in the course of the disease.
3- GT (computerized tomography) scans and ultrasound may be helpful in identification.
4- IDT and serological methods as IHA and ELISA may be of help.

**Treatment:**
1- Surgical removal.
2- Praziquantel: 50 mg/kg/day in 3 divided doses for 15 days (combined with corticosteroids to decrease inflammatory reactions and oedema that result from dying parasites).
3- Vitamin D and calcium to help calcification.

**Prevention and control:** see under *T. solium.*
**HYDATID DISEASE (Echinococciosis, hydatidosis)**

**Definition:** Human infection with hydatid cyst, the larval stage of *Echinococcus granulosus*

**Distribution:** Cosmopolitan.

**Morphology:**

1- **Adult:**
   - Size: about 5 mm.
   - Scolex: globular with 4 suckers and double crown of hooks (similar to *T. solium*).
   - Strobila: composed of 3 segments, one immature, one mature and one gravid. Mature segment: Longer than broad. Reproductive organs as *Taenia*.

   Gravid segment: Longer than broad.

   The uterus develops lateral pouches.

**Egg:** similar to *Taenia*

**Hydatid cyst:** a complex cyst composed of daughter and even grand daughter cysts inside and may be outside the mother cyst and contains several scolices. The commonest type is the unilocular cyst.

   - Size: 1-10 cm.
   - Shape: spherical enclosed in a fibrous capsule produced by the host. The wall of the cyst has 2 layers:
     - (a) Outer laminated non-cellular layer.
     - (b) Inner cellular (syncytial) germinal layer which secretes the laminated layer and produces scolices, brood capsules and daughter cysts.

**Contents:**

   - (a) Individual scolices (microscopic).
   - (b) Brood capsules: cysts formed by invagination of the germinal layer from which scolices develop.
   - (c) Daughter cysts: cysts formed of the 2 layers of the mother cyst, giving rise to scolices, brood capsules and even grand daughter cysts.
   - (d) Hydatid fluid.
   - (e) Hydatid sand: detached scolices, brood capsules and daughter cysts that fall in the hydatid fluid are called hydatid sand.
(f) Exogenous daughter cysts: a daughter cyst is produced outside the mother cyst by herniation through the fibrous capsule, and may separate from it.

Other types of hydatid cyst:
(a) Sterile cyst or acephalocyst: the germinal layer fails to produce scolices, brood capsules or daughter cysts.
(b) Osseous cyst: growth of hydatid cyst in bones is along the medullary cavity with erosion of osseous tissue.
(c) Alveolar or multilocular hydatid cyst: It is the larval stage of another species *Echinococcus multilocularis* or *Alveoceus multilocularis*.
   It differs from the common uni-locular variety in the following:
   i- There is no laminated layer, hence the cyst has no regular shape and not defined from the surrounding tissue. The germinal layer infiltrates the tissue.
   ii- There is no free fluid, but a jelly-like substance in irregular cavities separated by fibrous strands,
   iii- The central area of the cyst undergoes necrosis while growth continues at the periphery.
   iv- Growth is neoplastic and metastases occurs.
   v- In man the cyst is usually sterile or produces only few scolices and brood capsules.

**Life cycle:**
1- The adult worm lives in the small intestine of dogs (*E. granulosus*), foxes (*E. multilocularis*), or other carnivorous animals.
2- Mature eggs pass in the faeces.
3- When the egg is ingested by the intermediate host, herbivorous animals (*E. granulesus*), rodents (*E. multilocularis*) and occasionally man, the liberated onchosphere penetrates the intestinal wall into the bloodstream to various parts of the body where it develops into a hydatid cyst. The liver is the commonest organ affected followed by the lungs and then the brain and other organs.
4- The final host (carnivores) acquires the adult worm by ingestion of hydatid cyst.
Mode of human infection: Ingestion of eggs by the following ways:
1- Ingestion of water or vegetable polluted by infected dog faeces.
2- Handling or caressing infected dogs where the hairs are usually contaminated with eggs.

Pathogenicity: depends on the size of the cyst and the organ affected.
1- Pressure atrophy of the affected tissue.
2- Rutprue of the cyst results in anaphylactic shock and transplantation of the germinal layer in other tissues producing secondary cysts.

Diagnosis:
1- Clinically: a slowly growing cystic tumour (space occupying and pressure effects).
2- Eosinophilia.
3- X-ray: useful in pulmonary and calcified cysts.
4- CT and ultrasound may be helpful.
5- Hydatid thrill.
6- Puncture and aspiration: dangerous (anaphylactic shock).
7- Immunodiagnosis:
   (a) Intradermal test (Casoni test): 0.2 ml hydatid fluid (sterilized by filtration) injected intradermally produces a wheal in about 15 mn.
   (b) Serological methods:
      i- Precipitin reaction: equal parts of hydatid fluid and patient's serum incubated at 37°C for 1 hour show flocculation in 36 hours.
      ii- IHA (Indirect haemagglutination test).
      iii- LA (Latex agglutination test).
      iv- IEP (Immuno-electrophoresis test).

Treatment:
1- Surgical treatment: Removal or sterilization and drainage (aspiration of the hydatid fluid (contents) and replacement with 10% formaline (or hypertonic salt solution) to destroy the germinal layer (sterilization), the solution is withdrawn in 5 minutes, the cyst washed with saline and then collapsed.
3- Medical treatment: When surgical interference is impossible or contra- indicated, Mebendazole in high dose (20-40 mg/kg/day) for a long period (about 3 months).
Prevention and control:
1- Hydatid cysts found in slaughtered animals should be destroyed and not fed to dogs.
2- Stray dogs should be destroyed.
3- Pet dogs should be examined and dewormed periodically.
4- Avoid kissing and playing with dogs.
5- Avoid contamination of hands, food and drink with dog's faeces.

COENUROSIS

Definition: Human infection with Coenurus cerebralis, the larval stage of Multiceps multiceps.

Distribution: Cosmopolitan.

Life cycle:
1- The adults worm, Multiceps multiceps, lives in the small intestine of dogs and wild canines. It is about 50 cm in length.
2- Eggs (similar to Taenia eggs) pass in the faeces.
3- When the egg is swallowed by the intermediate host (herbivores specially sheep and rarely man) it develops into the larval stage, Coenurus cerebralis.
4- Coenurus cerebralis develops chiefly in the brain. It is a small transparent vesicle (3-5 cm) distended with watery fluid. It contains few macroscopic scolices but no brood capsules or daughter cysts.
5- The final host (dog) is infected on ingestion of the larval stage.

Pathogenicity:
1- In sheep infection with Coenurus cerebralis causes a fatal disease called gid.
2- In man there are symptoms of increased intracranial pressure as headache, convulsions, epilepsy and diplopia.

Diagnosis: difficult, diagnosed as brain tumour (X-ray and CT).

Treatment: surgical removal.

Prevention and control: as hydatid cyst.