Taenia saginata and solium

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Introduction

- Taeniasis is a tapeworm (cestode) infection acquired by the ingestion of raw or undercooked meat of infected animals.
- Although many species exist, two species, *Taenia saginata* and *Taenia solium*, cause pathology in humans.
- *T. saginata* is associated with the ingestion of the worm's larval form found in infected beef while *T. solium* is associated with that of infected pork.
- *T. saginata* is also commonly known as beef tapeworm. *T. solium* is similarily referred to as pork tapeworm.
Epidemiology

- Approximately 100 million new infections of Taenia worms develop annually throughout the world.
- Of which, approximately 50% of those infections are caused by each of the two worms equally.
- Infection rate is as low as 1 per 1000 in most of North America and as high as 10% in the third world.

Geographical distribution:
- These cestodes have a worldwide distribution but incidence is higher in developing countries.
- Though *T. solium* has worldwide distribution, but rarely found in the United States, where infection with *T. saginata* is frequently encountered.
Risk factors

✔ *T. saginata* infection is common in areas of the world where beef is commonly eaten and human sanitation is poor. It is common in Muslims because of eating beef.

✔ *T. solium* is more prevalent in poorer communities where humans live in close contact with pigs and eat undercooked pork. It is very rare in Muslim because of religious restriction for eating pork.
Taxonomy

✔ Kingdom - Animalia,
  – Phylum - Platyhelminthes,
    • Class - Cestodes,
    • Order - Cyclophyllidea,
      – Family - Taeniidae,
        • Genus - Taenia,
        • Species - T. saginata, T. solium
**Morphology**

✓ *T. saginata* can be up to 4 to 6 meters long and 12 mm broad; it has a pear-shaped head (scolex) with four suckers but no hooks or neck. It has a long flat body with several hundred segments (proglottids). Each segment is about 18 x 6 mm with a branched uterus (15-30 branches). The egg is $35 \times 45 \, \mu m$, roundish and yellow-brown. It has peripheral radial striations and contains an embryo with 3 hooklets (figure).

✓ *T. solium* is slightly smaller than *T. saginata*. It has a globular scolex with four suckers and a circular row of hooks (rostellum) that gives it a solar appearance. There is a neck and it has a long flat body (0.1 meter in length). The proglottids are $5 \times 10 \, mm$ with a 7-12 branch uterus. The eggs of *T. solium* and *T. saginata* are indistinguishable.
T. Saginata & solium

Taenia solium

Taenia saginata

Egg of Taenia (T. saginata or T. solium)

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Life cycle

1. Eggs or gravid proglottids in feces and passed into environment
2. Cattle (T. saginata) and pigs (T. solium) become infected by ingesting vegetation contaminated by eggs or gravid proglottids
3. Oncospheres hatch, penetrate intestinal wall, and circulate to musculature
4. Humans infected by ingesting raw or undercooked infected meat
5. Scolex attaches to intestine
6. Adults in small intestine

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Transmission
- In humans, it is the ingestion of under-cooked beef (*T. saginata*) or pork (*T. solium*) containing the larval cysts.
- Intermediate hosts, such as cows and pigs, are infected with the tapeworm when they come into contact with the worm's eggs located in the feces of infected humans.

Reservoir
- In addition to human, *T. saginata* also persists and has developmental stages in the cow. *T. solium* persists and has developmental stages in pigs.
Life cycle at a glance

Life cycle stages: Ova with future scolex, larva as cysticercus, adult as monocious segmented flat tape worm that is very long

Infective form: Cysticercus

Source: Infected beef or pork

Pathogenic form: Adult in intestine and cysticercus in tissues

Route of infection: Oral as eating undercooked infected meat

Site of development: Whole length small and large intestine

Abnormal site for Cysticircus cellulosae: Paranchymatous organs, brain, retina and skin
Virulence Factors

- There is no known secretory products as its virulence determinants.
- Survival in the intestine is the key to virulence. It survives on host’s nutrition. As it has no digestive system, nutrition is collected by absorption through its tegument that is equipped with numerous microvillous structures.
- Another aspect of virulence is the long survival period, that creates persistent and unresolved intestinal motility disorder of the host sufficiently linked to develop psychological outburst.
Pathogenesis

✓ Gastrointestinal symptoms are due to the presence of the tape worm.
✓ Rare intestinal blockage or penetration have been reported, but pathology is usually inconsequential although the psychological distress at passing motile segments may be extreme.
✓ Cysticercosis symptoms are a result of inflammatory/immune responses.
Clinical Features

- People infected with adult taenia often are asymptomatic.
- Infected people may become aware of infection by noticing proglottid segments of the tapeworm in their feces.
- Symptoms of infection, if any, are general: nausea, intestinal upset, vague abdominal symptoms such as hunger pains, diarrhea and/or constipation, or chronic indigestion. Increased eosinophils may be a sign of infection.
- A more severe form of taeniasis, cystercercosis, can occur upon ingestion of *T. solium* eggs found in the feces of infected humans. These eggs hatch in the small intestine and migrate to various tissues of the body and form cysts. *T. saginata* rarely causes cystercercosis.
- *Taenia saginata* taeniasis produces only mild abdominal symptoms. The most striking feature consists of the passage (active and passive) of proglottids. Occasionally, appendicitis or cholangitis can result from migrating proglottids. *Taenia solium* taeniasis is less frequently symptomatic than *Taenia saginata* taeniasis. The main symptom is often the passage (passive) of proglottids. The most important feature of *Taenia solium* taeniasis is the risk of development of cysticercosis.
Cysticercosis

- *T. solium* eggs can also infect humans and cause cysticercosis (larval cysts in lung, liver, eye and brain) resulting in blindness and neurological disorders.

- The incidence of cerebral cysticercosis can be as high as 1 per 1000 population and may account for up to 20% of neurological case in some countries (e.g., Mexico); cysticercosis ocular involvement occurs in about 2.5% of patients and muscular involvement is as high as 10% (India).

- The pathology associated with cysticercosis depends on which organs are infected and the number of cysticerci.

- For instance, a cysticercus in the eye might lead to blindness, a cysticercus in the spinal cord could lead to paralysis, or a cysticercus in the brain (neurocysticercosis) could lead to traumatic neurological damage or epileptic seizures. For this reason, cysticerci gather more attention when they occur in the central nervous system or the eye rather than when they develop in voluntary muscles.
Laboratory Diagnosis

✔ Principle:

- Microscopic identification of eggs and proglottids in feces is diagnostic for intestinal taeniasis and antibody detection in serum for cysticercosis.
Treatment

✔ Praziquantel is the drug of choice.
  - Expulsion of scolex must be assured to assume a satisfactory treatment.
  - A thorough inspection of beef and pork, adequate cooking or freezing of meat are effective precautions, since cysticerci do not survive temperatures below -10°C and above 50°C.

✔ Treatment of cysticercosis is very difficult with varying success: praziquantel + corticosteroids + albendazole.
Prevention

- Prevention is based on strict meat inspection, health education, cooking pork and beef well, hygiene and widespread sanitary installations.

- The best way to prevent taeniasis is to make sure that meat has been cooked properly and thoroughly by adequate boiling or heating. Freezing to -5°C for 4 days, -15°C for 3 days, or -24°C for 1 day kills the larvae as well.

- Good hygiene and hand washing after using the toilet will prevent self-infection in a person already infected with tapeworms in addition to contamination of foodstuffs by human feces.

- Proper disposal of feces, to avoid contamination of food, soil, and water, is important as well.
Summary

1. *Taenia saginata* and *Taenia solium* are two important members of the cestodes infecting man.

2. Two worms circulate between man and animals, so produce zoonoses.

3. Ova, larva as cysticercus and adult forms (monocious) are seen as life cycle stages. Ova of two species are similar, but larvae and segments with scolex are different.

4. Transmission is by eating undercooked beef or pork and there is autoinfection in case of *T. solium*.

5. Adult worm is segmented, flat and tape like, consist of scolex (head), neck (growing region) and strobila (body), which contain thousands of segments (proglottids). Distal segments are gravid and discharged with stool.
Summary

6. Adult worm in the intestine survive for a long period (even up to 20 years) and produce persistent gastro-intestinal motility disorder that leads to host psychological instability.

7. Accidentally, man develop cysticercosis by *T. solium* when eggs hatch in the intestine, invade tissues and produce chronic inflammatory lesions.

8. Diagnosis is done by examination of stool to see ova, segments and rarely scolex. Cysticercosis is diagnosed by antibody detection and histopathology.

9. Treatment is by Praziquental and prevention is by restricting consumption of undercooked beef and pork along with improvement of sanitary condition.
Study Questions

1. What do you know about prevalence and geographic distribution of taeniasis?
2. Describe morphology of *T. saginata* / *T. solium*.
3. Why adult taenia survive for a long period?
4. How does taenia worms collect their nutrition?
5. Give the mode of reproduction and egg discharge of Taenia.
6. Tabulate the differences between *T. saginata* and *T. solium*.
7. Outline the life cycle of Taenia.
8. Describe the pathogenesis of intestinal taeniasis and cysticercosis.
9. Write about the laboratory diagnosis of Taenia infection.
10. Write about the treatment, and control of Taenia infection.