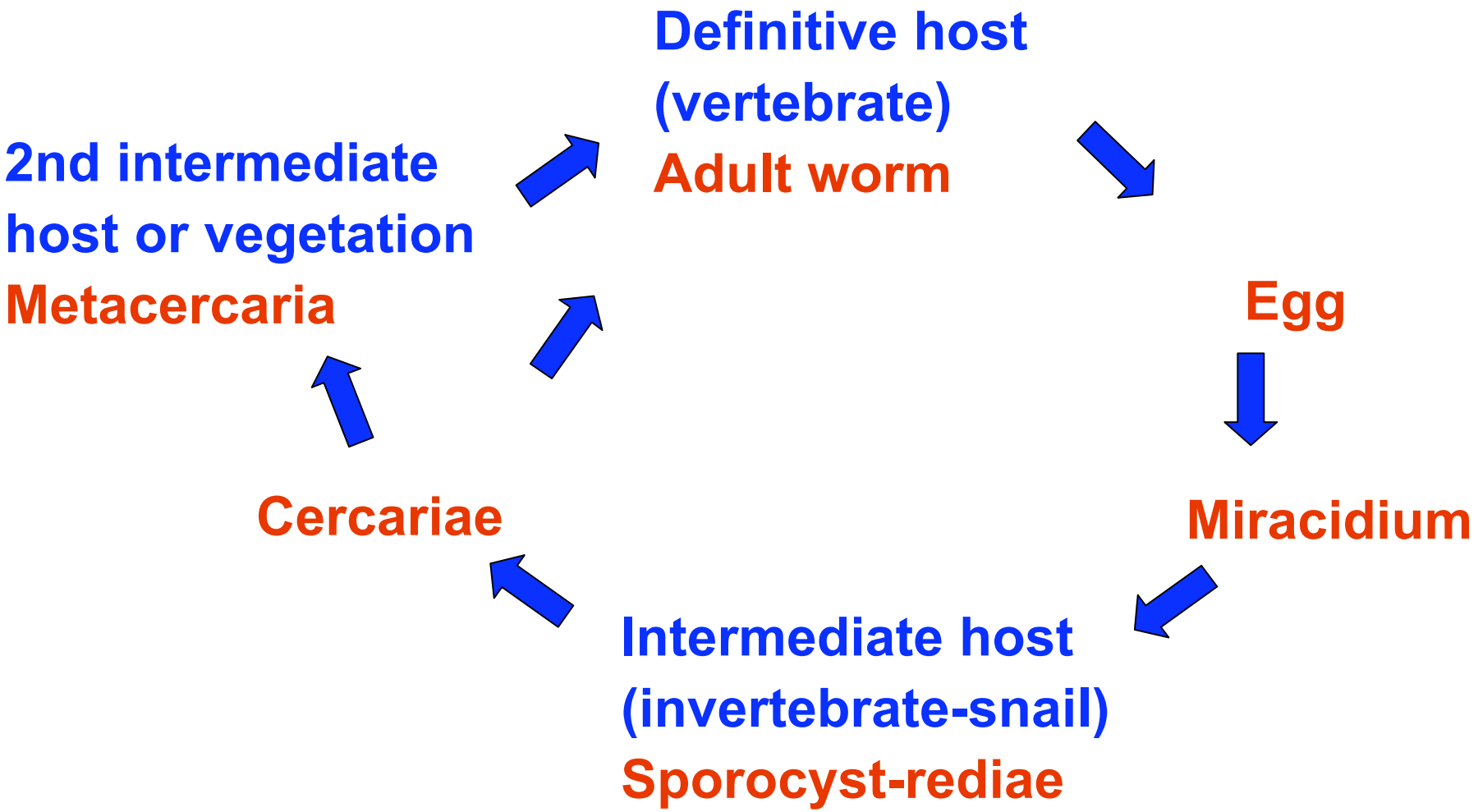
Human Trematodes…

Paragonimus westermai, Fasciolopsis buski , Fasciola hepatica

Trematode Life Cycle



Morphology: Adult Worm

- Vary widely in size- 0.16 cm to 5.7 X
- Two suckers- one near mouth, other c surface
- Syncytial tegument- heptalaminate in flukes
- Can persist for decades

Morphology: Egg/Miracidium

- **Eggs have distinctive shape.**
- **Embryos (not ova) hatch from shell.**
- **Miracidia of may species covered with ciliated epithelium.**
- **Limited time to find invertebrate host.**

Morphology: Sporocyst/Cercarieae

- Membrane-bound sac permeable to glucose and larger molecules.
- Contains asexually developing rediae
- Amplification of parasite: 1 miracidium gives rise to 20,000 cercariae.
- Cercariae are free-swimming and short-lived (24 h) if host not encountered.

Trematode Musculature

- **Layers (circular, longitudinal, diagonal) just under tegument and extending over their body.**

- **Suckers and pharynx often strongly developed.**

Trematode Reproduction

- **Most species hermaphroditic.**
- **Cross-fertilization when possible; self-fertilization when one worm present.**
- **Shell material supplied by vitelline glands adjacent to ovary.**
- **Egg contains embryo (not ovum)**
- **Egg shells operculated in many species**
- **Eggs sensitive to desication.**

Trematode Nutrient Acquisition

- **Bifurcated, blind gut.**
- **Ingests host blood and/or tissue.**
- **Brush border on cecal cells (within gut)**
- **Tegumental absorption of small molecules (glucose, amino acids).**

Trematode Nervous System

- Adult nerve endings sensitive only to touch.
- Cercariae have chemosensory endings similar to olfactory receptors.
- Miracidia have eyespot sensitive to light.

Human Trematodes

- **Lung fluke**
- **Intestinal fluke**
- **Liver fluke**
- **Blood fluke**

Lung Fluke-Paragonimiasis

- ***Paragonimas westermani*** **(8-12 X 4-6 mm)**

Paragonimiasis-Definition

- **Infection by trematodes of the genus Paragonimus.**
- **Most frequently *P. westermani*.**
- **Sixteen species pathogenic to humans:**
- ***P. westermani*, *P. heterotremus*, *P. uterobilateralis*, *P. calensis*, *P. kellicotti*, *P. mexican*, *P. congolensis*, *P. amazonicus*, *P. skrijabini*, *P. miyazaki*, *P. africanus*, *P. peruvianus*, *P. ecuadoriensis*, *P. philippinensis*, *P. huerlungensis*, and *P. pulmonatis*.**

Paragonimiasis-Geographic Destribution

- **Wide distribution in China, Japan, Korea, Taiwan, Philippines, Indonesia, and smaller areas of India and Nepal.**
- ***Paragonimus* species have been reported from Canada, North and Central America, and parts of South America.**
- ***P. africanus* has been reported from Cameroon, Nigeria, Libya, Liberia, and Zaire.**

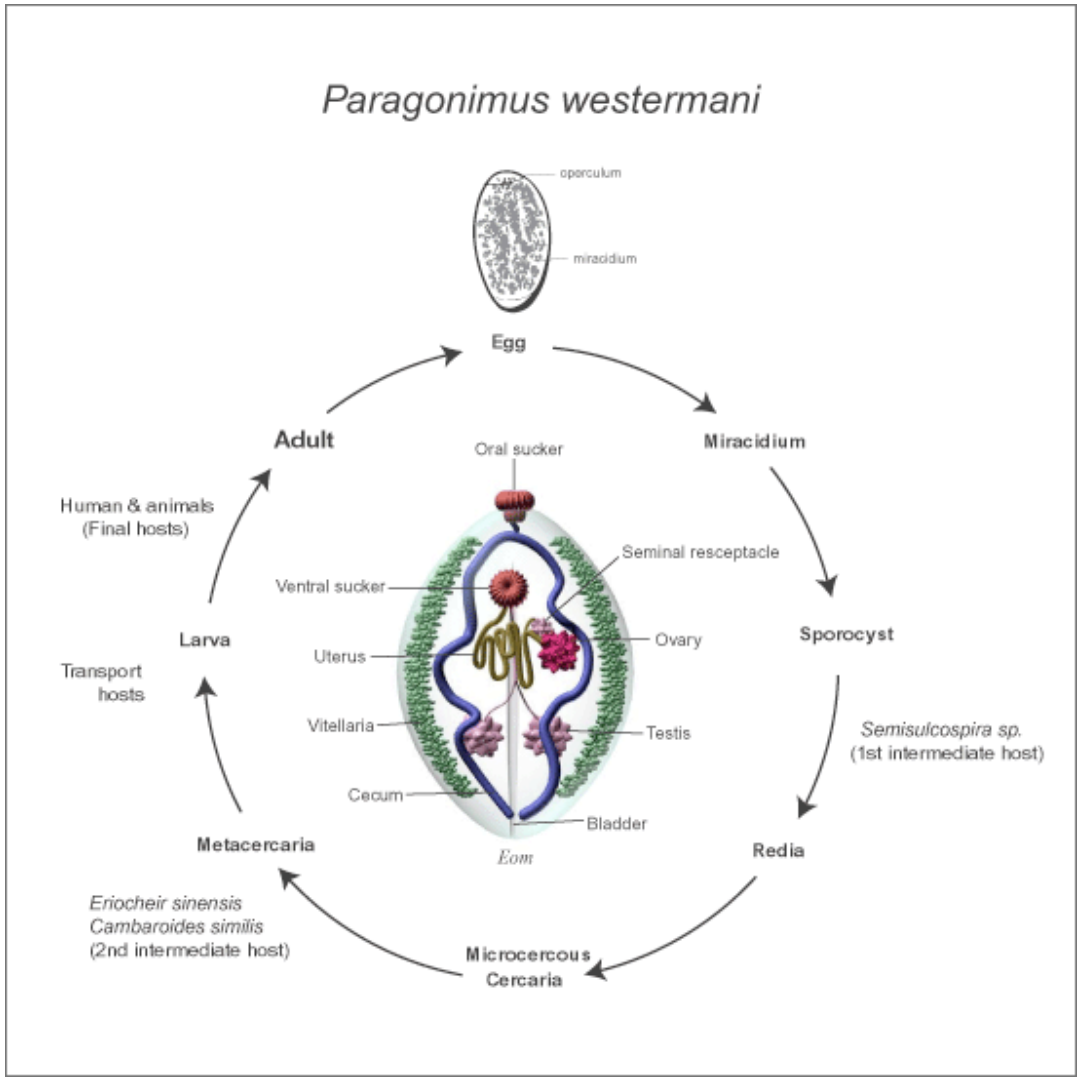
Paragonimiasis-Habitat

- **Adult trematodes live, encapsulated, in the lungs of humans—usually in pairs within a cyst.**
- **Reservoir hosts include domestic and wild dogs, wolves, foxes, members of the cat family as well as pigs, monkeys, rats, mongooses and opossums.**
  - **Kerbert (in 1878) described the adult worm that he isolated at autopsy from a Bengal tiger.**
  - **Life cycle established in 1916 by Nakagawa**

Paragonimiasis-Morphology

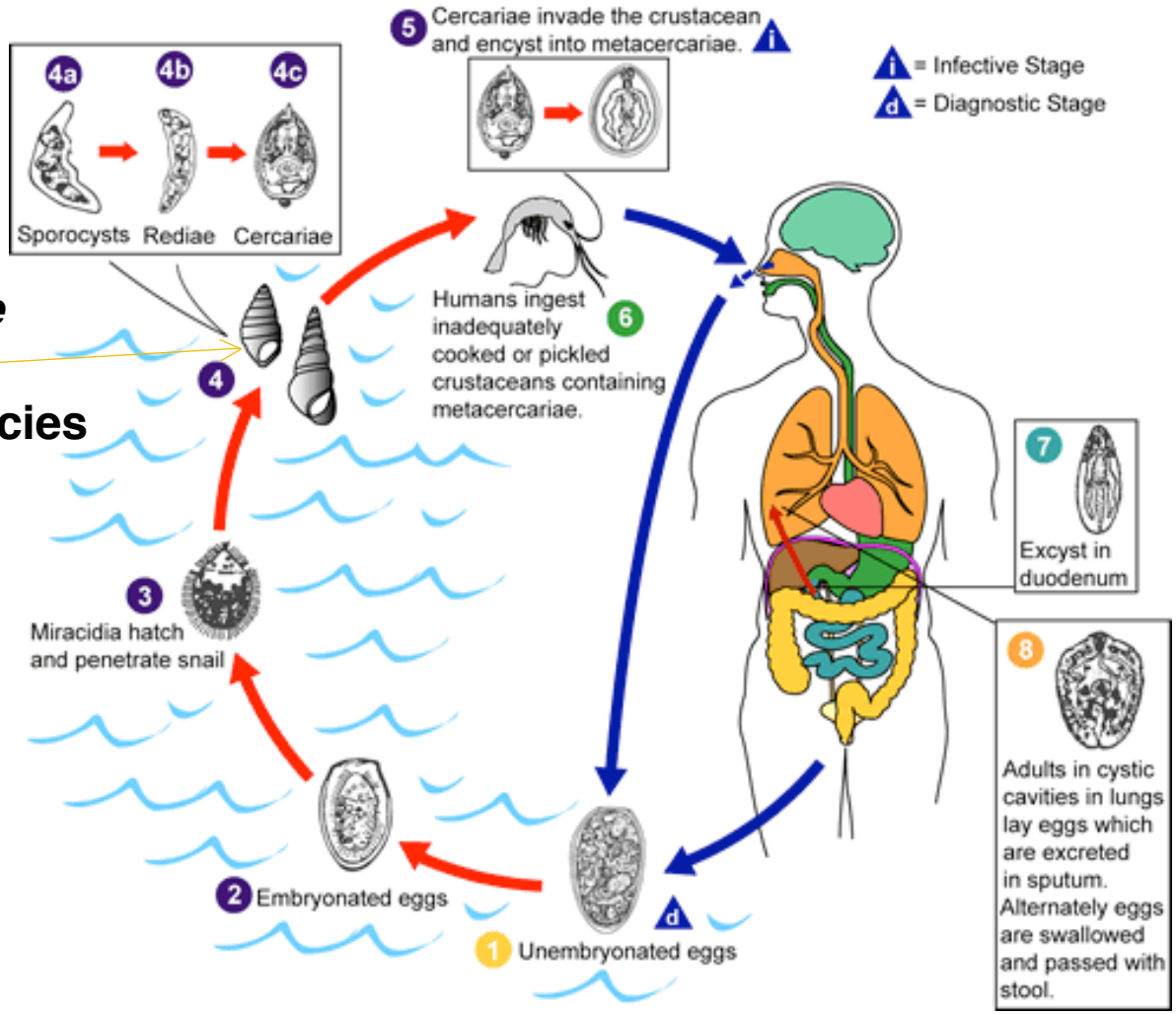
- **Adult fluke is thick, fleshy, egg-shaped, red-brown, rounded anteriorly and slightly tapered posteriorly.**
- **Eggs are golden brown, oval, and thick shelled (80-120 *μ*m by 45-65 *μ*m and have a flattened operculum at one end.**

Paragonimiasis-Morphology



P. westermani Life Cycle

Pleuroceridae
and
***Thiaridea* species**



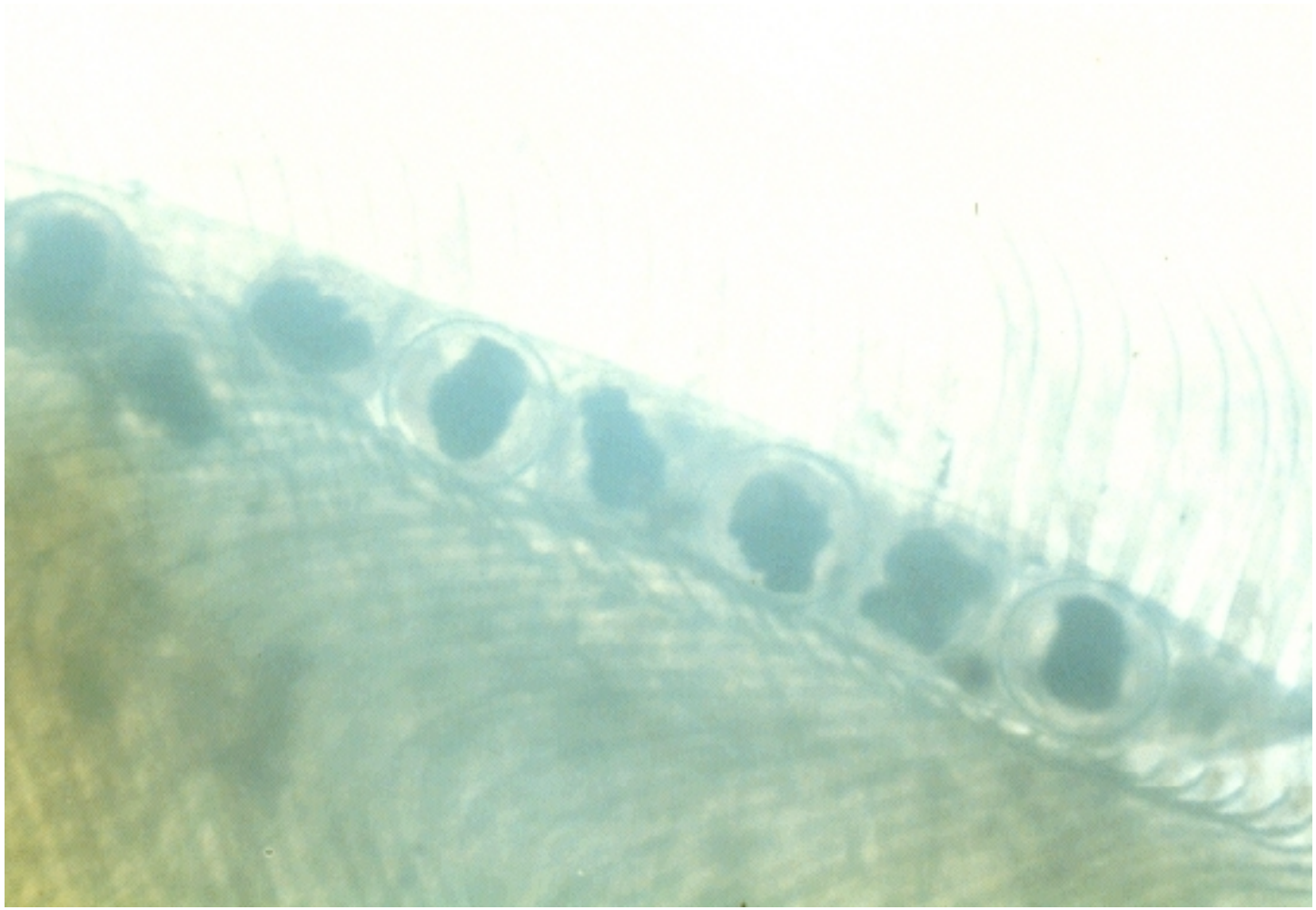
Paragonimiasis-Egg

- **In unsuitable final hosts the metacercariae encyst in the tissues (paratenic host *e.g.*, pigs and remain there until ingested by appropriate hosts, which then allows the life cycle to repeat.**

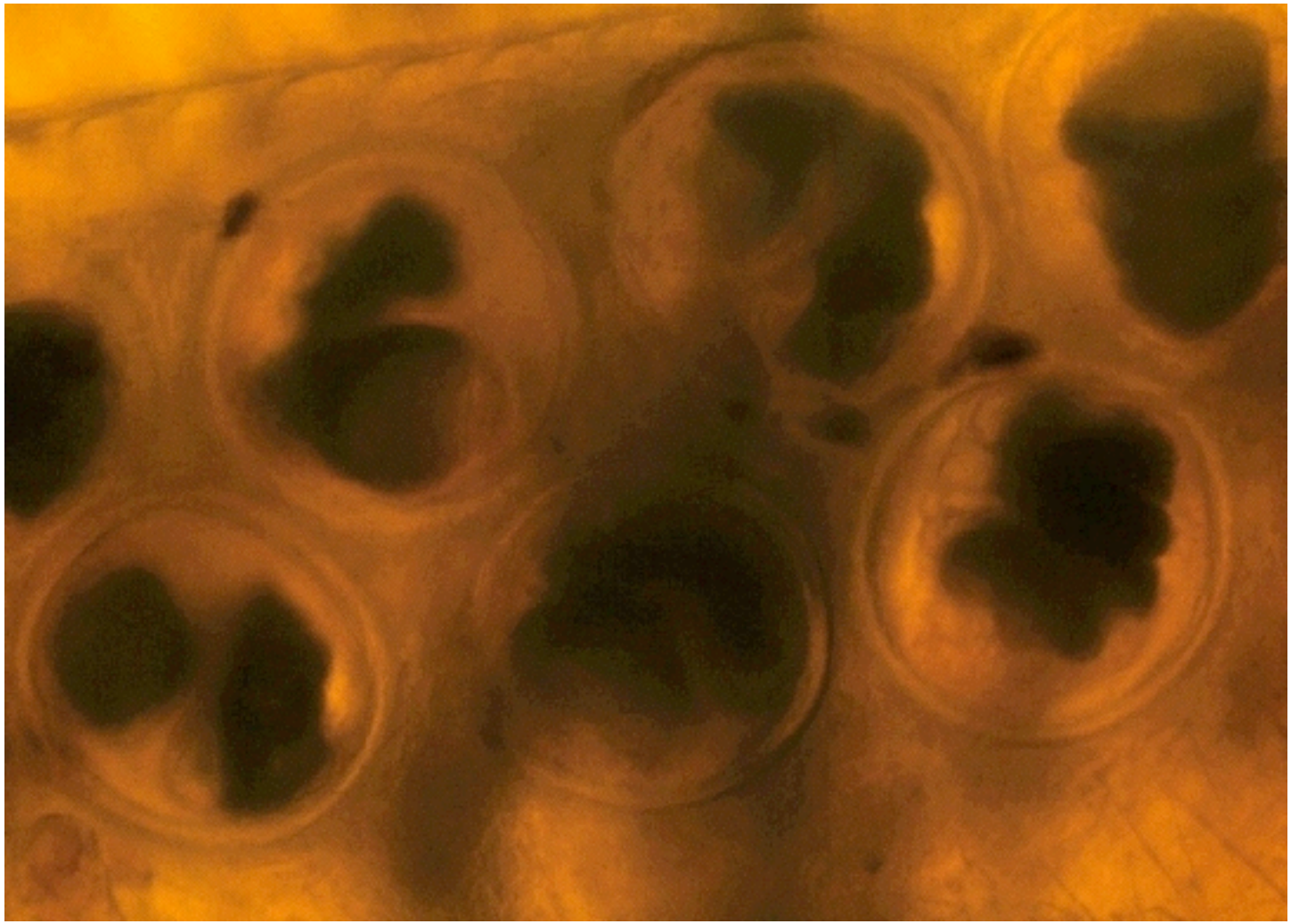
Paragonimus miracidium

2nd Intermediate Host--Crab

Metacercariae on Gill



Metacercariae Close-Up



Clinical manifestations

ACUTE-EXTRAPULMONARY

- 2-20 days
- Diarrhea
- Abdominal pain
- Urticaria

CHRONIC-PULMONARY

- Cough
- Fever
- Malaise
- Chest pain
- Dyspnea
- Blood-tinged sputum or thick chocolate-brown sputum containing eggs.

Pulmonary Pathology

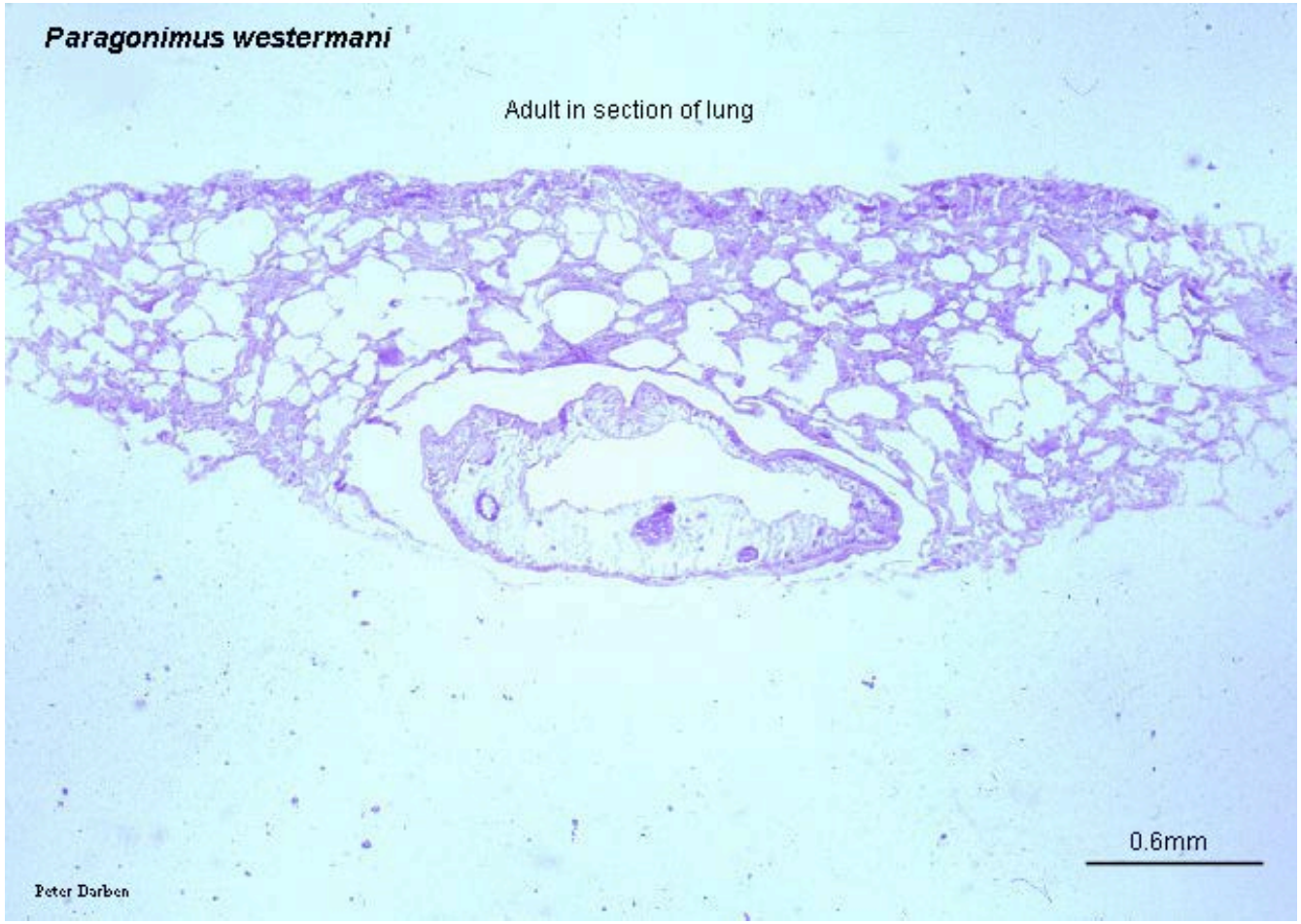
- Allergic and toxic reactions.
- Cysts 1-2 cm; 1-2 worms/cyst.
- Usually about 20 worms/lung.
- Fibrous capsule
- Hemorrhage and inflammation.
- May abnormally migrate to heart, brain, peritoneal cavity (other places).

Extrapulmonary Pathology

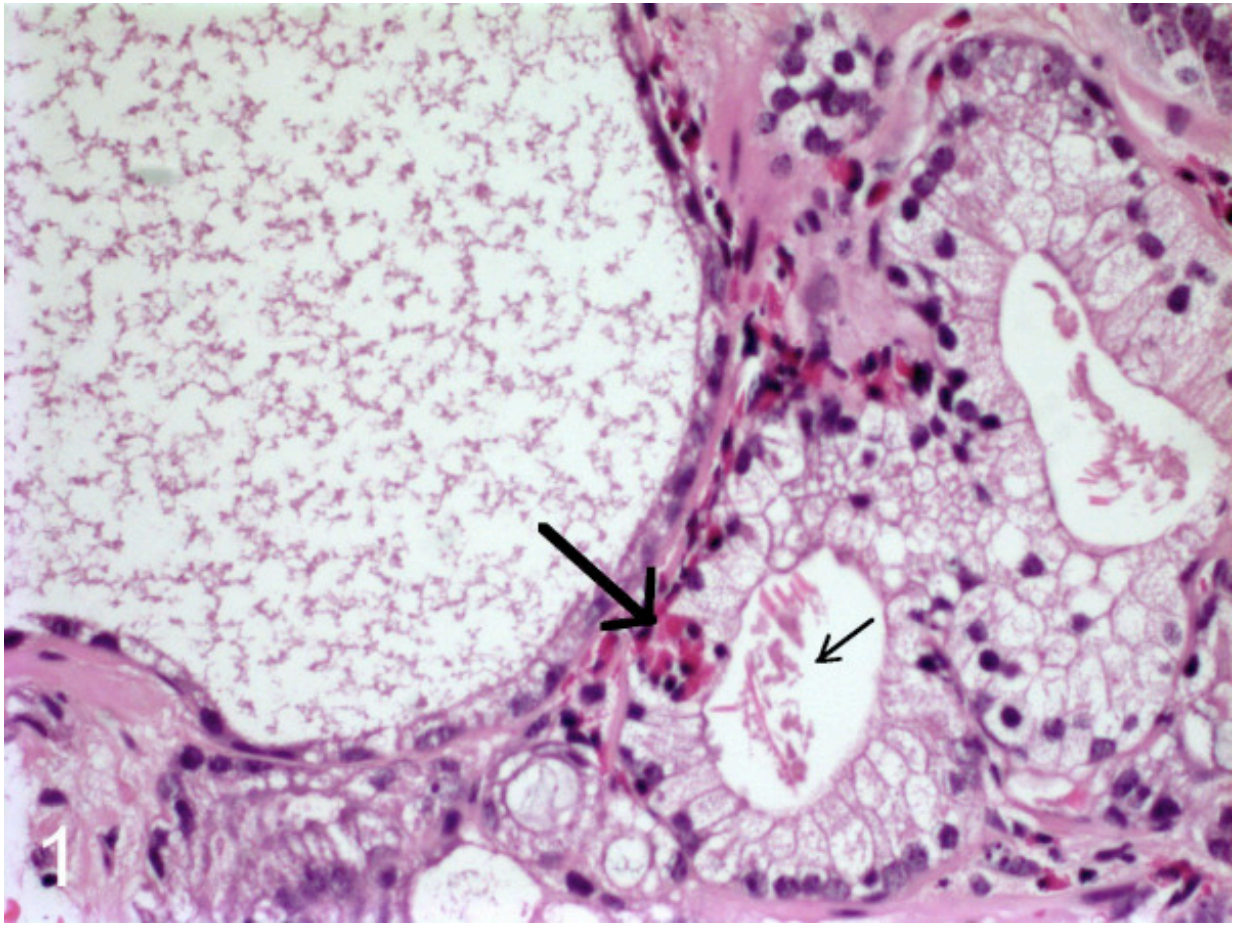
- **Brain most common extrapulmonary site of infection.**
- **Cerebral hemorrhage, especially in children <15 years of age.**
- **In Korea, 90% of <15 year old patients have cerebral involvement and become mentally retarded.**

Pulmonary Worm Pair

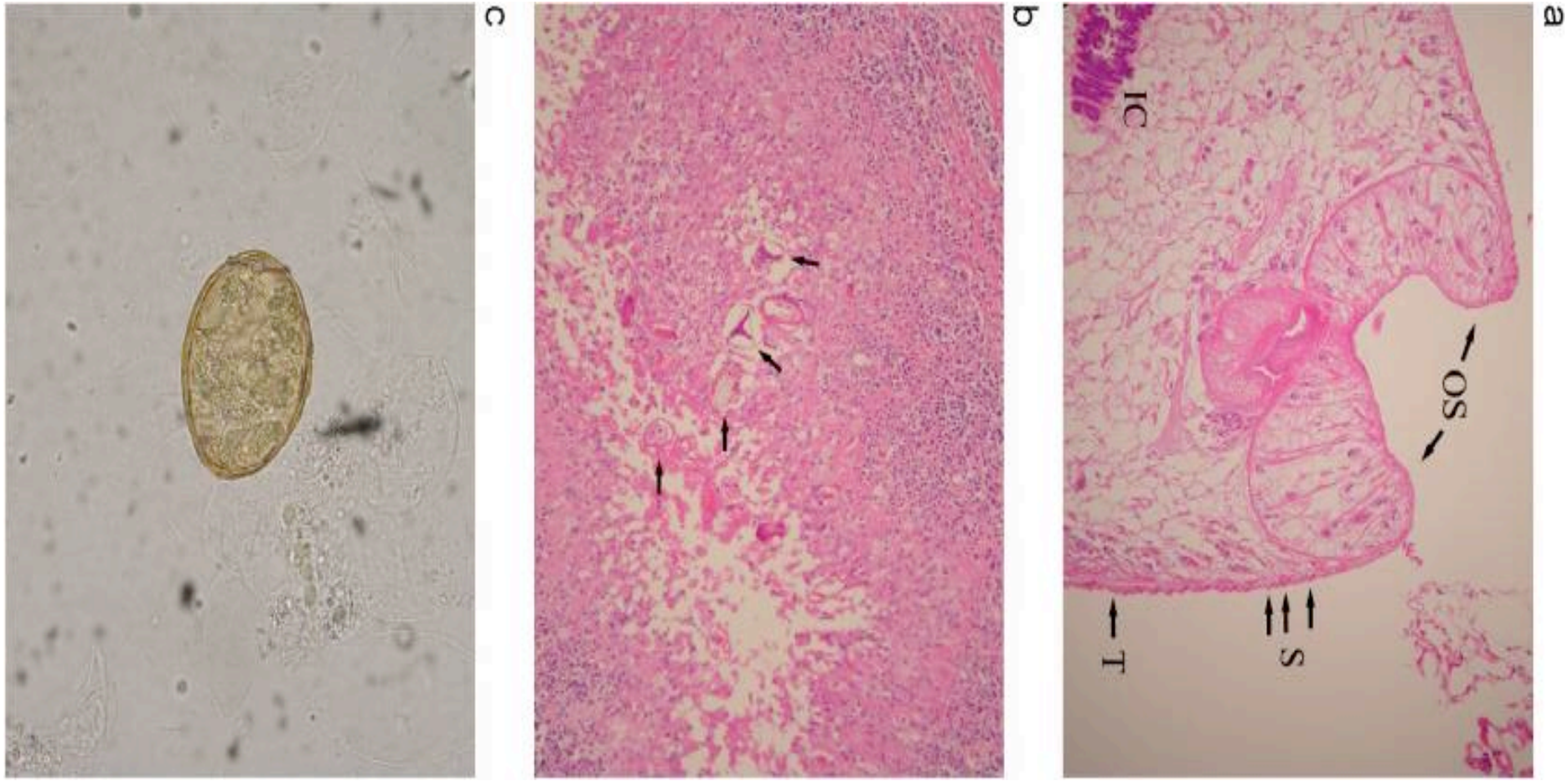
Granulomatous Reaction Around Eggs



Charcot-Leyden Crystals



Egg Granulomas



Diagnosis and Control

- Ova in sputum or feces.
- Chest X-ray and/or CT.
- ELISA
- Eosinophilia and history of travel to endemic region(s).
- Praziquantel (3 days).
- Molluscicides, health education, carful food preparation.

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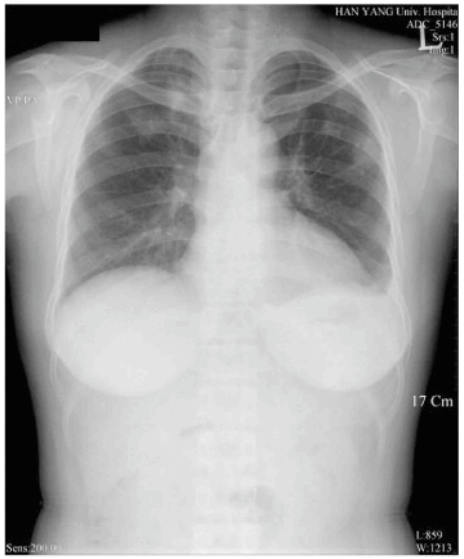

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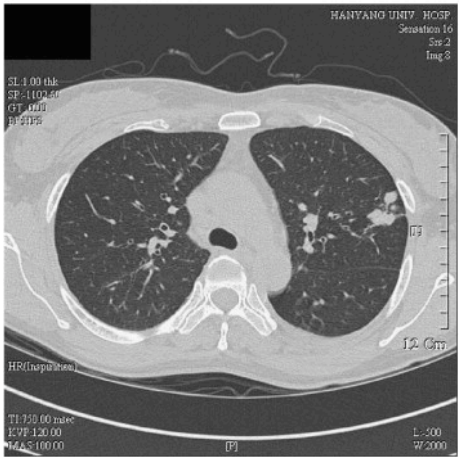
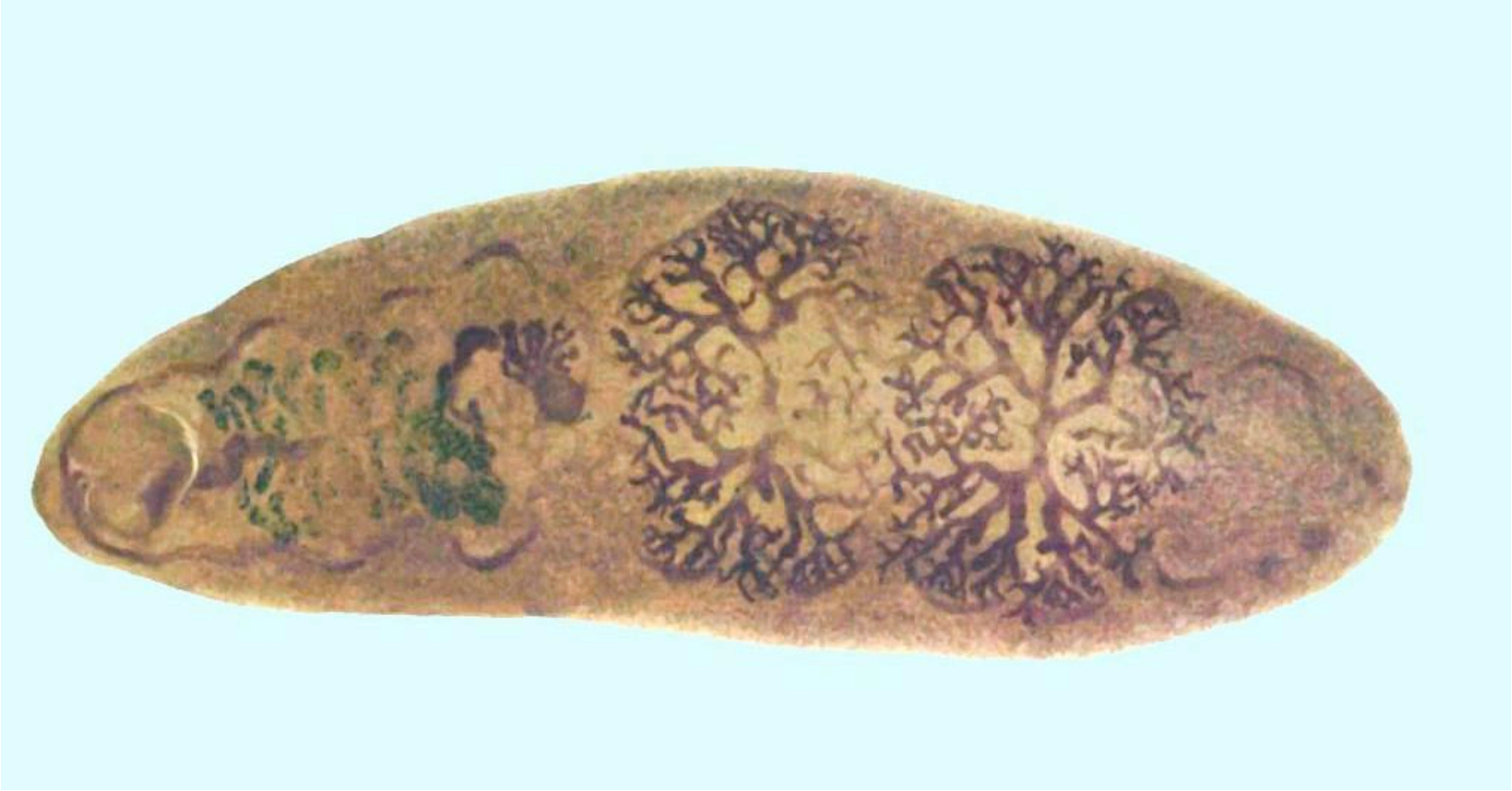


Intestinal fluke: *Fasciolopsis buski*



Fasciolopsiasis-Definition

- **Fasciolopsiasis is infection by *Fasciolopsis buski*, one of the largest parasites to infect humans.**

- **In addition to humans, the dog, pig, and sometimes water buffalo are infected.**

Fasciolopsiasis-Epidemiology

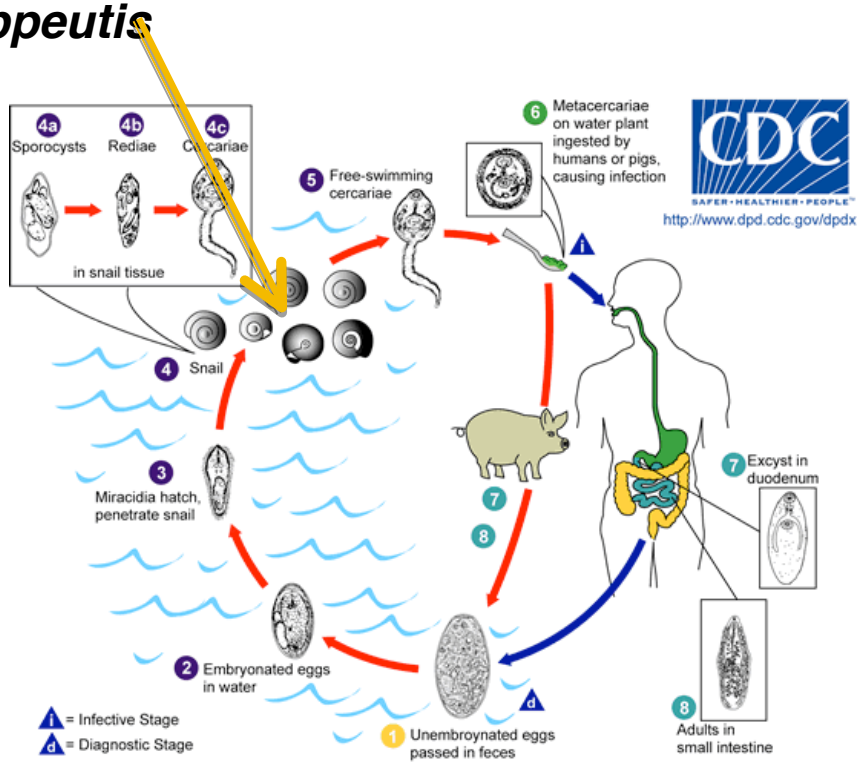
- ***Fasciolopsis buski*** **is found mainly in East Asia, especially India, Bangladesh, Thailand, Eastern China, Taiwan, Vietnam, East Pakistan, and Laos.**
- **The incidence of fasciolopsiasis among children in Southern Taiwan was found by one investigator to be 25.1%.**

Fasciolopsis buski-Morphology

- **Mature fluke is oval, flat, and elongated 2-7.5 cm long by 8-20 mm wide and 0.5-3 mm thick.**
- **No cephalic cone.**
- **Eggs are large and daily egg production can reach 25,000 per fluke.**

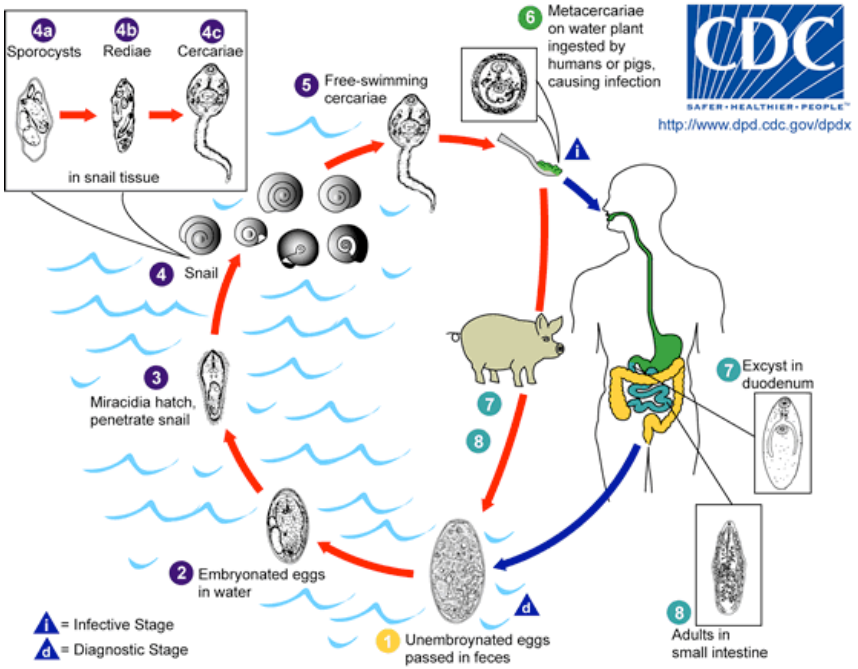
F. buski Life Cycle

Segmentia* and *Hippeutis



F. buski-Life Cycle

- **Cercariae released from the snail encyst on freshwater plants especially seed pods of water caltrop, the bulb of water-chestnut, water bamboo and water hyacinth, and there become metacercariae.**
- **Up to 3.6% of the total encysted cercariae have been found to float on the water surface.**
  - **On study showed that 13% of humans and 40% of pigs could become infected via this route.**



Fasciolopsiasis-Clinical Manifestations

- Diarrhea
- Jaundice
- Abdominal pain
- Bloody stools
- Edema of face, trunk, limbs
- Ascites

Fasciolopsiasis-Pathology

- **Damage at site of attachment.**
- **Inflammation, erosion, hemorrhage.**
- **Intestinal obstruction in heavy infection.**

Fasciolopsiasis-Diagnosis and Control

- Fecal examination for ova.
  - No immunologic method useful in diagnosis.
- Praziquantel.
- Cooking water plants.
- Molluscicides.
- Pigs-controlled access to water source.

Liver Fluke-*Fasciola hepatica*

Fascioliasis-Definition

- **Fascioliasis is any infection caused by the genus *Fasciola*.**
- **Three species infect humans: *F. hepatica, F. gigantica, F. indica*.**
- **Although rare in humans, fascioliasis is a common liver infection in cattle, sheep, and other herbivores.**

Fascioliasis-Epidemiology

- **Zoonotic disease, prevails where livestock, snails, and humans are close together.**
- **Most infections are acquired by ingesting uncooked watercress.**
- **Human outbreaks have been reported from France, Spain, England, Cuba, Chile, and Uruguay.**
- **Sporadic infections in the US, West Indies, China, Thailand, North and East Africa, South Africa, Iraq, Vietnam, and Russia.**
- **In several Chilean provinces, the prevalence of human infection reaches 75%.**

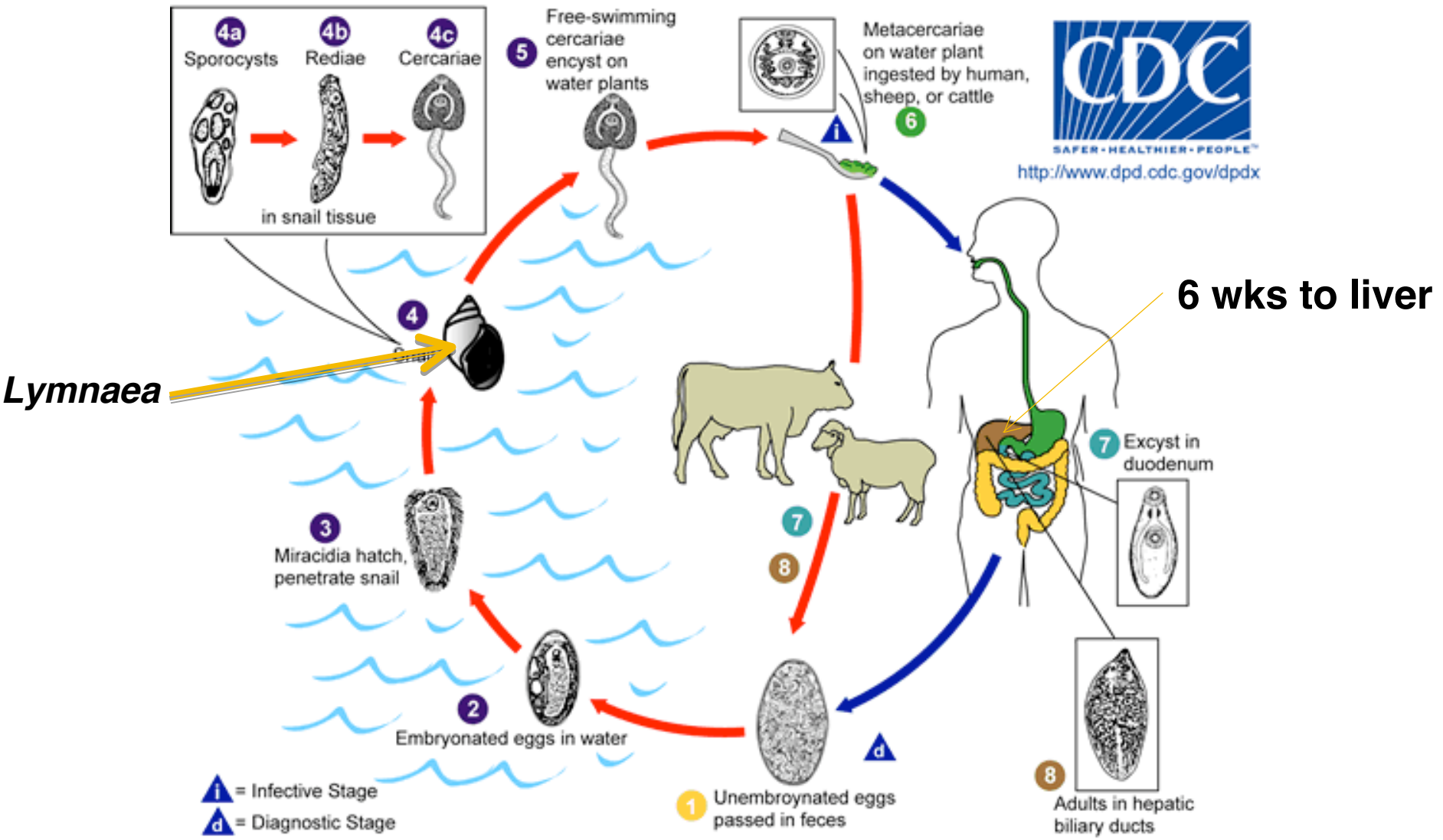
Fascioliasis-Epidemiology

- **Human transmission appears to be maximal during the late summer, following infection of snails earlier in the season.**
- **More common in young adults.**
- **Up to 50% of sheep and up to 70% of cattle are infected in some parts of the world.**
- **Economic loss from animal mortality, weight loss, reduced reproductive efficiency, and liver contamination in areas with significant incidence of fascioiliasis is significant.**

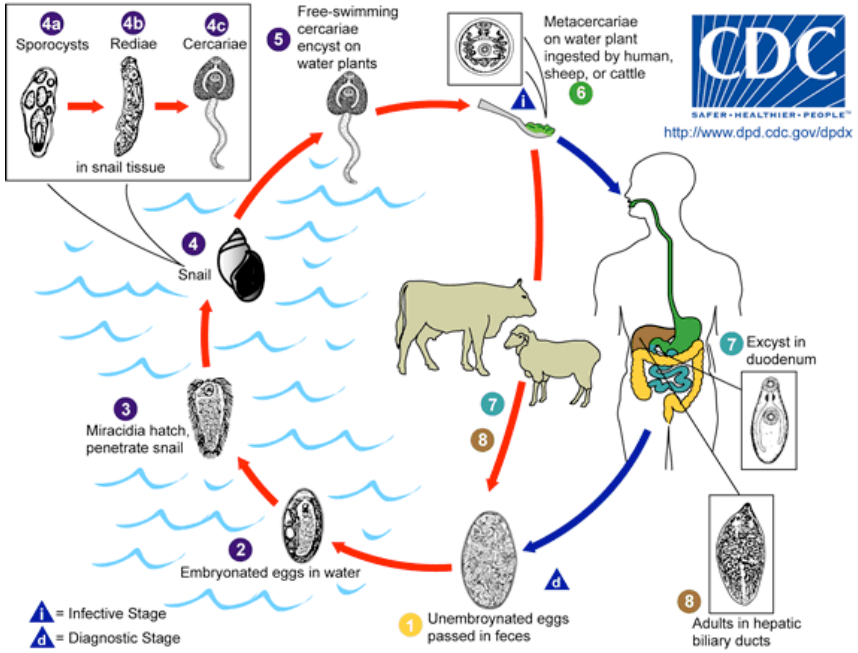
F. hepatica-Morphology

- **Adult worm is a large leaf-shaped fluke 20-40 mm by 8-13 mm.**
- **Brown to pale gray.**
- **Conical projection.**
- **Ventral sucker 12x larger than the oral sucker.**
- **The branching of the cecae distinguishes this parasite from the closely-related trematode *F. buski*.**
- **However, eggs are indistinguishable from those of *F. buski*.**

F. hepatica-Life Cycle



F. hepatica-Cerceria



F. hepatica-Immune Response

- **Inflammation present at time of infection decreases fluke burden 40-50%.**
- **Anti-inflammatory agents given before or during infection increase worm burden.**
- **Suggest that the acute inflammatory response of the host to *F. hepatica* may mediate the extent of infection.**
- **It appears also that localized reactions within the intestine of previously infected hosts play a role in resisting reinfection.**

F. hepatica-Immune Response

- **Conversely, *F. hepatica* evades immunity by secreting various mediators of immunity (*i.e.*, immunoglobulins, eosinophils, neutrophils and the complement cascade.**
- **Key factor is cathepsin L which cleaves immunoglobulins at the hinge region.**

F. hepatica-Clinical Manifestations

ACUTE-MIGRATORY

- **3-4 months**
- **Dyspepsia**
- **Abdominal pain**
- **Nausea**
- **Vomiting**
- **Fever**
- **Urticaria (allergic)**
- **Hepatomegaly**

CHRONIC-BILIARY PHASE

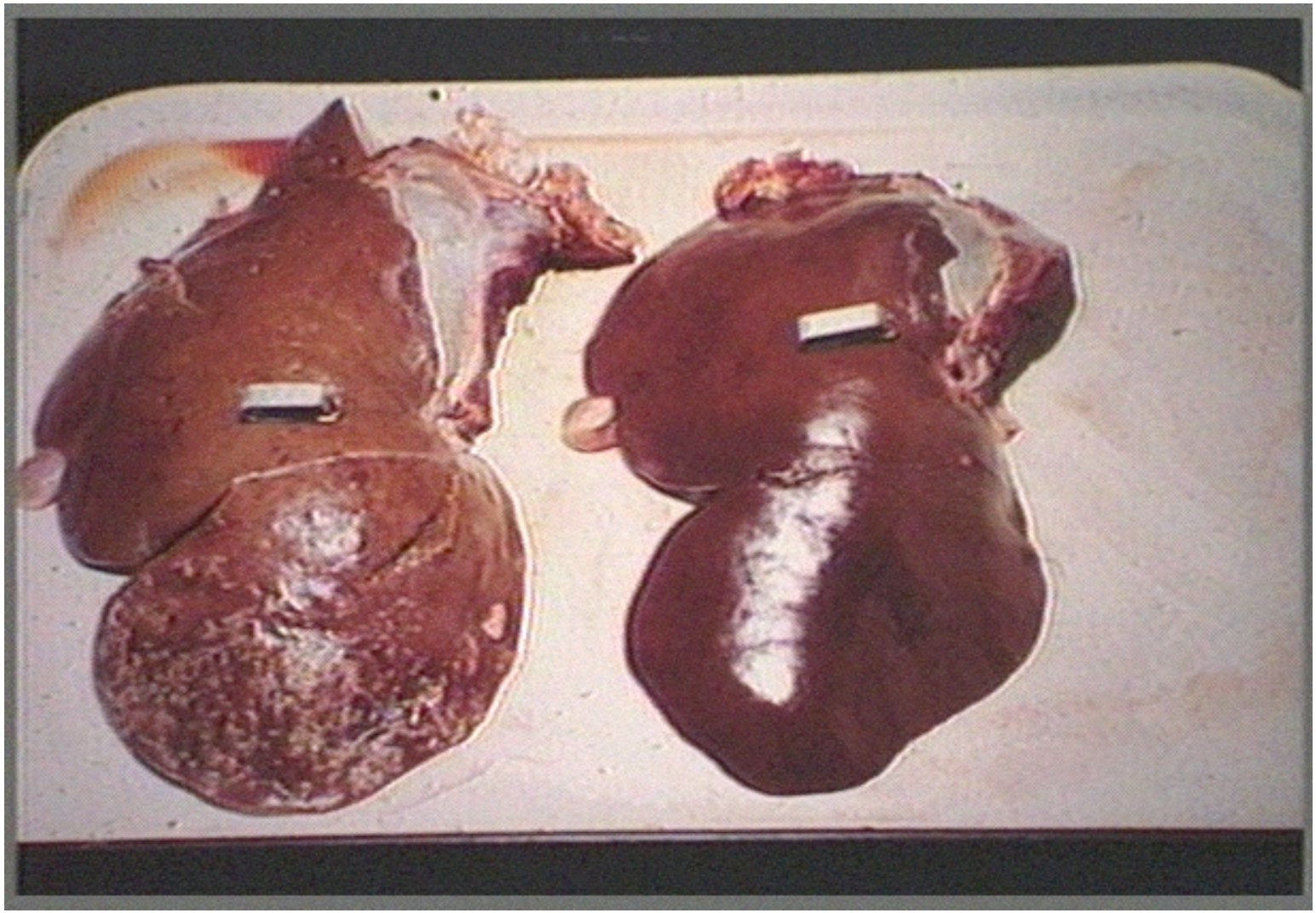
- **Often few symptoms.**
- **Pain**
- **Nausea**
- **Vomiting**
- **Obstructive jaundice**

- **Halzoun (suffocation)**
  - **Dyspnea, edema, deafness, asphyxia.**

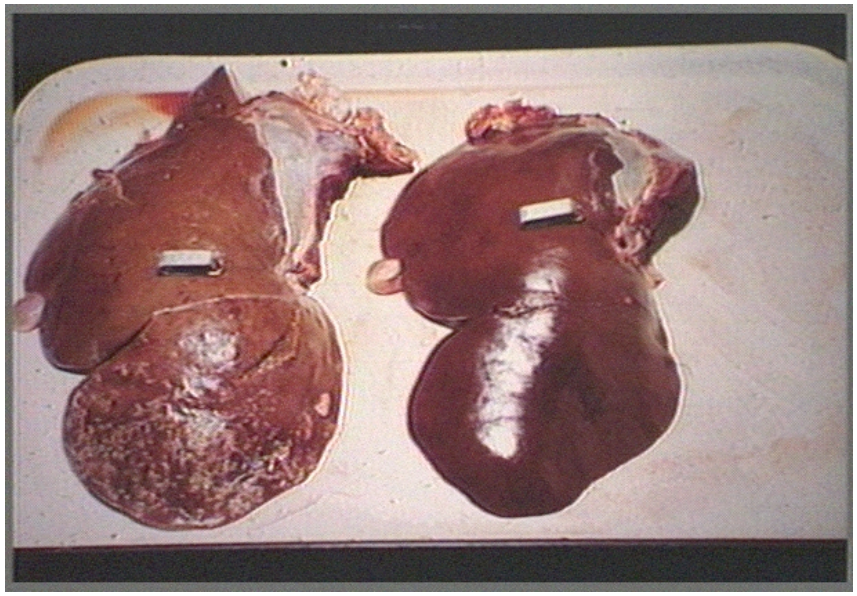
F. hepatica-Pathology

- **Eosinophilia.**
- **Abnormal liver function tests.**
- **Liver necrosis (600 cause death in sheep).**
- **0.2 ml blood consumed per day per worm.**
- **Blockage of bile ducts (mimics stones).**
- **Abnormal migration (abscesses in lungs, heart, skin, brain).**

Infected and Normal Livers

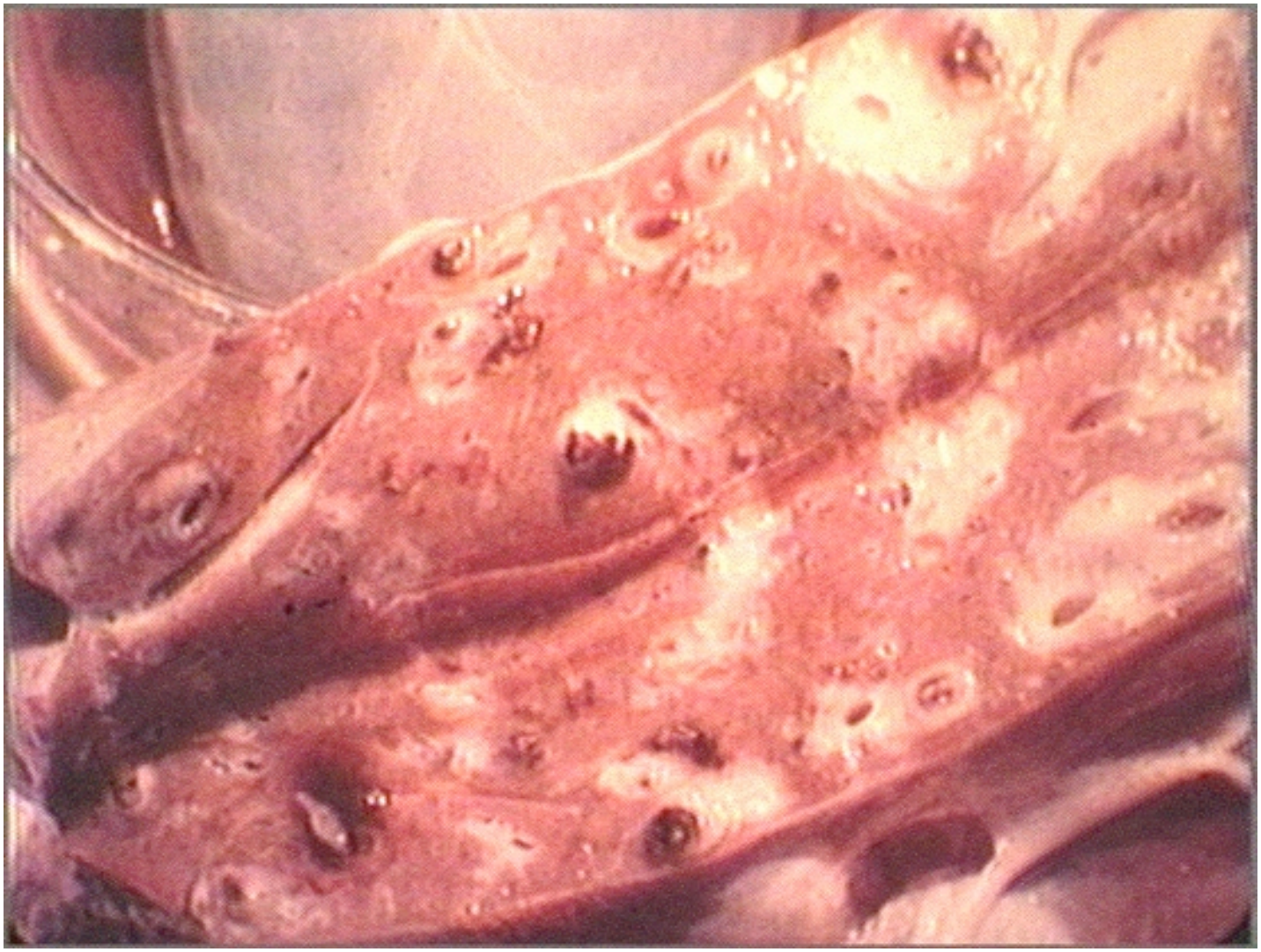


Infected and Normal Livers

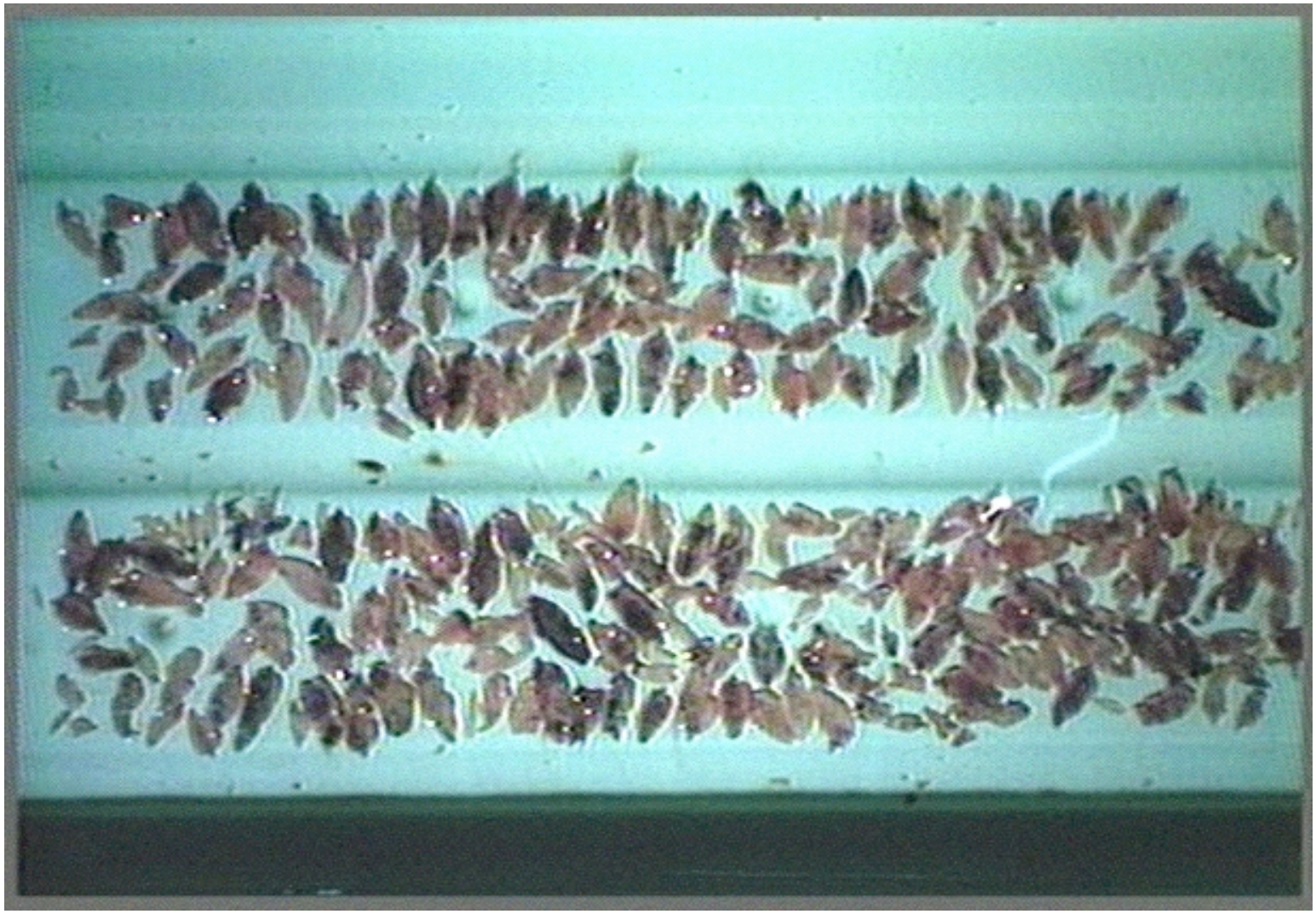


- Destruction of liver mainly mechanical.
- Coagulative necrosis
- Patchy hemorrhages
- *F. hepatica* produces large quantities of proline which causes bile epithelial hypertrophy, creating a lawn of cells from which to feed.

Liver Damage



Worms from One Bovine Liver



Adult Work Cross Section

Diagnosis and Control

- **ELISA**
- **Eradicate the disease in livestock.**
- **Use molluscicides.**
- **Avoid uncooked water plants and contaminated water**
- **Drug of choice is bithionol.**
  - **Also praziquantel.**

The Usual Suspects