Parasitic and Mycotic Zoonoses of the Dog

Canine Scabies (Sarcoptic mange)

Life cycle of *Sarcoptes scabei var. canis*

Cross sectional view of the burrows created in the epithelium by *S. scabei*. 

*Burrowing mite, Sarcoptes scabei var. canis*
**Clinical Signs**

• Non-seasonal, mite infestation with intense pruritus
• Acquired from prolonged contact with infested pet
• Children are most at risk
• Typical location is on the hands, especially the webbing between the fingers

**Diagnosis**

• Skin scraping
• Direct visualization on microscopy

**Treatment**

• Easily cured with scabicidal dips (e.g., Lindane) once weekly
• All clothes, bedding, and towels used by the infested person during the 2 days before treatment should be washed in hot water, and dried in a hot dryer.
• A second treatment with the same lotion may be necessary 7-10 days later.

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**Cheyletiellosis**

- *Cheyletiella yasguri*
  - “Walking dandruff”
  - Non-burrowing, obligatory mite
  - Lives in the keratin layer of the dermis
  - Not associated with hair follicles

<table>
<thead>
<tr>
<th>EGG</th>
<th>LARVA</th>
<th>NYMPH I</th>
<th>NYMPH II</th>
<th>ADULT</th>
</tr>
</thead>
<tbody>
<tr>
<td>white, attached by fine cocoon to base of hair</td>
<td>(6 legs) White, 7 1/2 days</td>
<td>(8 legs) White, 4 1/2 days</td>
<td>(8 legs) White to Yellow, 5 days</td>
<td>(8 legs) Yellowish, moves rapidly 14 days</td>
</tr>
</tbody>
</table>

- The mite is highly contagious, especially between puppies 2-8 weeks of age.
- Adult dogs are usually lightly infected even when in direct contact with infected puppies and very few mites or eggs can be demonstrated in debris from their coats. Older individuals may be almost symptomless carriers.
### Clinical Signs

- May appear asymptomatic
- Infestation is non-seasonal
- Scale (dandruff) formation.
- Large numbers of small white *Cheyletiella* mites moving about on the skin surface
- **Pruritus** – variable, Erythematous skin
- Crusts, Papules (small swellings/spots)

### Cheyletiellosis

- Selenium sulphide-based shampoos
- Dips in pyrethrin, lime sulfur, amitraz
- Injections of ivermectin should NOT be used in Beagles, Collies, Shelties or Collie-crosses.
- The environment should be treated by using a vacuum and use of an environmental flea control spray
  
  **Prognosis:** good

### Treatment

### Diagnosis

- Routine skin scraping of mites or eggs under a microscope
- Scotch tape or combing
- Sometimes found during routine microscopic examination of sodium nitrate fecal floatations

- The mites are large (385 mm)
- Live on the skin surface
- Eggs are attached to hair shafts

### Prognosis: good

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### Cheyletiella in Humans

- **Transmission** of skin infestation from dogs, usually puppies, by direct human contact or through contaminated clothing.

- Well demarcated, single or grouped erythematous macules that progress to intensely pruritic papules on arms or torso.

- Cycle with in the human is incomplete, creating a self-limiting infestation within the human, usually within 3 weeks if contact with infested animal is terminated.

- **Treatment:** any insecticidal topical medication is likely to be effective, e.g. Lindane lotion.
Toxocariasis: Visceral larva migrans, Ocular larva migrans

Visceral larva migrans is an infection with the larval form of the parasite *Toxocara canis*, associated with dogs which can affect a person’s eyes, lungs, liver, brain, and heart.

**Causes, incidence, and risk factors**

This infection is caused by ingestion of eggs from the dog parasite called *Toxocara canis*. The worm inhabit the intestinal tract of infected dogs and their eggs appear in abundance in the feces of these animals.

However, the parasite is not infectious until 2-3 weeks after it has been excreted -- so the major risk factor for this infection is not the animal feces but the soil into which the eggs have passed. Humans may ingest the eggs by eating unwashed raw vegetables.

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**Life Cycle of Toxocara**

Young children with pica are at highest risk, but this infection can also occur in adults. People can also become infected by eating raw liver.

After ingestion, the eggs hatch into larvae in the gastrointestinal tract and are carried into the circulation and to various tissues -- primarily the lung, liver, and eyes. The brain, heart, and other organs can also be affected.
Epidemiology

• In the US: The seroprevalence of *Toxocara* infection in children varies from 2-10%.
• International incidence is likely similar or slightly higher.
• Mortality/Morbidity: Death is rare. Long-term morbidity is present with ocular larva migrans (i.e., loss of vision in the affected eye) but not usually with VLM.
• Race: Infection rates are higher among African Americans and Hispanic Americans, likely because of greater exposure to the parasite.
• Age: Infection primarily affects children aged 1-4 years, but it can occur at any age.

Treatment

• This infection is usually self-limiting and may not require therapy. Certain anti-parasitic drugs may also be used such as diethylcarbamazine, albendazole, or mebendazole.

Prevention

• Deworming of dogs and cats and minimizing exposure of children to areas that may be contaminated with animal feces are important preventive measures. Hand washing after handling soil is also important.

Toxocariasis: Symptoms & Diagnosis in Humans

Symptoms

• Individuals with mild infections may have no symptoms
• Common clinical signs include: nausea, fever, myalgia, hepatomegaly, edema, urticaria, irritability, abdominal pain.
• Pulmonary symptoms are common and include cough, shortness of breath, and wheezing.
• If the eyes are infected, loss of vision and strabismus may occur.

Diagnosis

• CBC: leukocytosis and eosinophilia.
• An enlarged liver, rash, and lung or eye abnormalities may also be noted.
• The disease may be definitively diagnosed by detection of larvae in the affected tissue.
• A blood test for antibodies can also be used to detect infection.
Cutaneous Larva Migrans

- Cutaneous larva migrans (CLM) is the most common tropically acquired dermatosis.
- Erythematous, pruritic, cutaneous eruption caused by percutaneous penetration and subsequent migration of larvae.
- It is found most commonly in tropical/subtropical geographic areas and the southwestern United States.
- The ease and increasing incidence of foreign travel by the world’s population has no longer confined CLM to these areas.

![Cutaneous larva migrans (Hookworm)](image-url)
Cutaneous Larva Migrans

Geographic Distribution

*Ancylostoma braziliense* (hookworm of wild and domestic dogs and cats) is the most common cause. It can be found in the central and southern US, Central America, South America, and the Caribbean.

*Ancylostoma caninum* (dog hookworm)

- Found in Australia

*Uncinaria stenocephala* (dog hookworm)

- Found in Europe

Pathophysiology: Humans are accidental hosts, and it is believed that the larvae lack the collagenase enzymes required to penetrate the basement membrane to invade the dermis. Therefore the disease remains limited to the skin when humans are infected.

Cutaneous Larva Migrans

Clinical Signs in Humans:

- Distribution occurs on the dorsa of feet, interdigital spaces of toes, anogenital region, buttocks, hands, and knees.

- Tingling/prickling at site of exposure within 30 minutes of penetration of larvae

- Intense pruritus

- Erythematous, often linear lesions that advance

- Often associated with history of sunbathing, walking barefoot on the beach or similar activity in a tropical location

- Predispositions include the following:
  - Hobbies and occupations in contact with warm, moist, sandy soil, (Tropical/subtropical climate travel, barefoot beachgoers/sunbathers, children in sandboxes, carpenter, Electrician, Plumber, Farmer, Gardener, Pest exterminator)

Morbidity: The condition is benign but can cause a disturbing pruritus.
### Cutaneous Larva Migrans

**Diagnosis**
- Based on classic clinical appearance of the eruption.
- Microscopic identification of eggs in the stool is the most common method for diagnosing hookworm infection.
- A minority of patients demonstrate peripheral eosinophilia on a CBC and increased IgE levels on total serum immunoglobulins.
- A skin biopsy, taken just ahead of the leading edge of a tract, may show a larva (PAS +) in a burrow, basal layer tracts, spongiosis with intraepidermal vesicles, necrotic keratinocytes, and an epidermal and upper dermal chronic inflammatory infiltrate with many eosinophils.

**Treatment**
- Topical Thiabendazole for early, localized lesions with the oral route for widespread lesions or unsuccessful topical treatment.
- Other effective treatments include albendazole, mebendazole, and ivermectin.

**Prognosis**
- Excellent
- This is a self-limiting disease. Humans are accidental, dead-end hosts with the larva dying and lesions resolving within 4-8 weeks, as long as 1 year in rare cases.

### Cutaneous Larva Migrans: Tungiasis

- *Tunga penetrans* L. is a flea that lives in Central and South America, sub-Saharan Africa and Central Asia.
- Infestation by *Tunga penetrans* is characterized clinically by the slow appearance of papular or nodular lesions, either single or multiple, white or greyish or yellowish in colour, with a brown-black central tip that corresponds to the posterior portion of the flea. These lesions may be more or less erythematous, painful, occasionally covered by brownish-black crusts; sometimes they are ulcerative or pustular. Characteristic localizations of tungiasis are toes, particularly peri- and subungual folds, interdigital spaces, sole and heel. Rare in USA (less than 20 cases reported).
- *Tunga penetrans* L. is a parasite of the skin. Apart from man, this flea can also infest pigs, dogs, cats, sheep, horses, mules, cattle, rats, mice and even gorillas in captivity. The natural habitat of *Tunga penetrans* L. is represented by the sandy and warm soil of deserts and beaches; furthermore, the flea lives in stables and stock farms, as well as in soil and dust close to farms.
- Treatment consisting the surgical removal of the papular/nodular lesion or removal of the flea, possibly intact and apply a topical antibiotic.
**PARASITIC ZOONOSES**

**Dipylidiasis** *(Dipylidium caninum)*

**Epidemiology:** Dogs and cats commonly infested. Fleas ingest eggs, which then develop into cysticercus stage. Humans, mainly children, get infected when fleas are accidentally ingested.

**Symptoms:**
- **Dogs:** mainly asymptomatic, gastroenteritis, poor haircoat.
- **Humans:** eosinophilia, mild GI discomfort.

**Diagnosis:** Demonstration of proglottids in a stool sample.

**Treatment:** Niclosamide.

**Prevention:** Prevent toddlers to eat foreign objects, wash hands, treat pet cats against ectoparasites.

*www.nlc.net.au/~nedved/Parasites/ Fleatapeworm.html*
Life Cycle of Dipylidium caninum

- Adult flea harbours the infective cysticercoid.
- Host is infected by ingesting fleas containing cysticercoid.
- Animals can transmit the infected fleas to humans.
- Gravid proglottids are passed intact in the feces or emerge from perineal region of either animal or human hosts.
- Each proglottid contains egg packets that are held together by an outer embryonic membrane (see 2). The proglottids disintegrate and release the egg packets.
- Eggs become infective by 7 to 10 days.
- Humans, normally children, acquire the infection by ingesting the infected flea.
- Scolex attaches in intestine.
- Adult in small intestine.

Prevention of Dipylidium Infection

- Control fleas on your pet and in their indoor and outdoor environments.
- Have your veterinarian treat your dogs and cats promptly if they have tapeworms.
- Clean up after your pet, especially in playgrounds and public parks. Bury the feces, or place it in a plastic bag and then put it in the trash.
- Do not allow children to play in areas that are soiled with pet or other animal feces.
- Teach children to always wash their hands after playing with dogs and cats and after playing outdoors.
Echinococcosis: *E. granulosus*

- **Epidemiology**
  - Rare in USA (Southwest, Alaska), common in Mexico
  - Humans infected by direct contact with infested dogs (particularly children not washing their hands)
  - Indirect contamination by contaminated water or raw vegetables

- **Cystic echinococcosis**
- **Cystic hydatid disease**
Echinococcosis: *E. multilocularis*

**Epidemiology**
- Fox main reservoir, common in northern Mid West in USA and Alaska (dogs main source of human infection there).
- Humans infected by direct contact with infested dogs (particularly children not washing their hands).
- Indirect contamination by contaminated water or raw vegetables, berries.

*Alveolar echinococcosis*
Echinococcosis: Disease in humans

- **E. granulosus**
  - Cysts in the liver and lungs that grow to 10 cm.
  - Signs consistent with space occupying lesions
  - Rupture of cysts may cause anaphylaxis

- **E. multilocularis**
  - Tumor-like proliferation of hepatic cysts with metastasis
  - Often fatal

Echinococcosis: Treatment and Prevention

**Treatment**

- Surgical removal of cysts
- Follow-up treatment with albendazole or mebendazole

**Prevention**

- Prevent exposure to dog feces
- Treat domestic dogs for tapeworms (praziquantel)
- Block canine access to the viscera of intermediate hosts
Canine Heartworm Disease

- Common Disease in Dogs, Rare in Humans
- Distribution – Worldwide
  - Warm, humid area (over 27°C for 2 weeks)
- Causative Agent – *Dirofilaria immitis*
- Vector Transmission through Mosquitoes
- Host – Dogs, some wild carnivores
  - Dogs – main reservoir
  - Cats, humans – dead end host

Canine Heartworm – Life Cycle

The Life Cycle of *Dirofilaria immitis*
(The Canine Heartworm)

- Microfilariae are found in the dog's bloodstream.
- The vector ingests microfilariae during a blood meal.
- Juveniles migrate to the right side of the heart and mature into males and females.
- The microfilariae mature into infective juveniles.
- Infective juveniles are introduced into the dog when the vector feeds.
Canine Heartworm in Dogs

- Mature worms reproduce in right ventricle
- Pulmonary arteries occlusion due to proliferation of intima
  - Pulmonary hypertension
  - Right ventricle hypertrophy
  - Cough, exercise intolerance, syncope
  - Death

Canine Heartworm in Humans

- Adult worms cannot reproduce in human heart
- Eventually die and lodge in lungs
  - Pulmonary nodules
  - Over 50% asymptomatic
    - Incidental findings
  - Cough, malaise, mild fever, hemoptysis
- Nodules are surgically excised
Canine Heartworm Disease
Prevention and Control

- Vector control
  - Mosquito Abatement
  - Sewage improvement
  - Chemical control

- Heartworm Preventative for Pet Dogs

- Treatment of Infected Dogs
  - Adulticidal treatment
  - Microfilarial treatment
  - Surgical removal

Strongyloidiasis

- *Strongyloides stercoralis*
- Not common, found in Southern USA (warm tropical and subtropical countries)
- Dogs asymptomatic or diarrhea, bronchopneumonia
- Humans: abdominal pain, diarrhea alternating with constipation
- Massive infestation can lead to fever, liver tenderness, nausea, vomiting weight loss, severe diarrhea.
- Life threatening infection in immunocompromised individuals
- Treatment: thiabendazole
Strongyloidiasis

- **Distribution**: Central and South America
- **16-18 million cases worldwide**
  - 21,000 annual death
  - 300,000 new cases/year
- **Causative Agent**: *Trypanosoma cruzi*
- **Vector**: Triatomines (Kissing bugs)
- **Reservoir**: Humans, Dogs, etc.

American Trypanosomiasis (Chagas’ Disease)

- **Distribution**: Central and South America
- **16-18 million cases worldwide**
  - 21,000 annual death
  - 300,000 new cases/year
- **Causative Agent**: *Trypanosoma cruzi*
- **Vector**: Triatomines (Kissing bugs)
- **Reservoir**: Humans, Dogs, etc.
Trypanosoma cruzi – Life Cycle

Trypanosoma cruzi parasites in hindgut of a field-collected triatomine bugs.
Chagas’ disease – Clinical Signs

- Acute
- Chronic

Chagas Disease in a Domestic Transmission Cycle, Southern Texas, USA

“After three dogs died from acute Chagas cardiomyopathy at one location, an investigation was conducted of the home, garage, and grounds of the owner. A serologic study was conducted on stray dogs, and an ecologic niche model was developed to predict areas where the vector *Triatoma gerstaeckeri* might be expected.”
Chagas’ disease

- Diagnosis
  - Microscopic Examination
  - Antibody Detection (IFA, EFA)
- Treatment
  - Acute – Benznidazole or Nifurtimox
  - Chronic – Symptomatic Approach
- Prevention and Control
  - Residual Pesticides in House
  - House Improvement
  - Don’t sleep with dogs!

Cutaneous Leishmaniasis
Highly Endemic Countries (90% of cases)

http://www.medicine.mcgill.ca/tropmed/imagesystemicprot/mapcutleish.jpg
Global distribution of Leishmaniasis

Symptoms of Leishmaniasis

**HUMANS (visceral disease):**
- weight loss
- cough
- fever
- diarrhea
- Hepatosplenomegaly
- lethargy
- **Cutaneous Disease:**
  Mucocutaneous lesion at infection site

**DOGS (visceral form):**
- extreme weakness / lameness / wasting
- Diarrhea
- epistaxis
- anemia
- renal failure
- edema of the feet
- dermal ulceration
- eye inflammation leading to blindness
- lymphadenopathy
- hepatosplenomegaly
The Reemergence of Visceral Leishmaniasis in Brazil
Jorge R. Arias, Ph.D.,* Pedro S. Monteiro,† and Fabio Zicker, M.D., Ph.D.‡

Emerging Infectious Diseases * Volume 2 * Number 2  April-June 1996

• Urban and Peri-Urban Outbreaks in Brazil
• Risk Group: Poor, malnourished children
• Risk Factors: contact with DOGS, chickens and horses, substandard housing, poor hygiene
• Associated with a large migration to the city area due to a decrease in farming area.

• USA: since 1999: Epidemic in Fox Hounds….not human cases related yet to it
• Treatment: Pentostam, Pentamindine, Allopurinol, Ketoconazole, Amphotericin B and Pentostam-Nifurtamox

Prevention of Leishmaniasis

Prevention of biting from Sand flies:
• Avoid outdoor activities from dusk to dawn
• Wear protective clothes
• Spray repellant on exposed skin
• Spray insecticide on clothing and living areas
• Use a bed net
Paragonimiasis

Distribution

P. westermani

North America - P. kellicotti
- Mississippi basin
- Atlantic coast
- Midwest
- Ontario & Quebec
**Paragonimus in Humans**

**Acute phase - during tissue migration**
- Eosinophilic peritonitis & pleuritis
- Rarely - Brain involvement

**Chronic phase**
- Intermittent cough
- Dyspnea
- Hemoptysis

**Treatment and Prevention**

**Treatment**
- Praziquantel (Biltricide) is the drug of choice for paragonimiasis

**Prevention**
- Avoid eating undercooked and pickled crustaceans (Tourists sampling “native” foods)
- Don’t allow pets to eat raw shellfish
- Control snails using molluscicides
Clonorchiasis & Opisthorchiasis

Distribution

30 million people infected

C. sinensis
- Chinese or oriental liver fluke

O. viverrini
- Southeast Asian liver fluke

O. felineus
- Cat liver fluke
- Former Soviet Union

Geographic distribution of Clonorchis sinensis and Opisthorchis viverrini

C. sinensis and O. viverrini: green
C. sinensis: red
O. viverrini: orange
Clonorchiasis in Humans

- Often asymptomatic
- Local irritation of bile ducts: loss of appetite, sense of abdominal pressure
- Rarely - bile duct occlusion jaundice, cirrhosis, hepatomegaly, ascites, and edema
- A significant risk factor for cholangiocarcinoma

Treatment and Prevention

**Treatment**
- Praziquantel (Biltricide) is the drug of choice for clonorchiasis

**Prevention**
- Avoid eating undercooked freshwater fish
- Control fish imports from endemic regions
- Don’t allow pets to eat raw fish
Respiratory Capillariasis

- 3 major zoonotic capillariasis
- Distribution – Worldwide, Common in USA
- Causative Agent – *Eucoleus aerophilus*
  - Formerly *Capillaria aerophila*
- Definitive Host – Carnivores
  - Canids
  - Cats
  - Martens
- Intermediate Host – Earthworm?
- Rare infection in Humans

*Eucoleus aerophilus* – Life Cycle

- Female produce numerous eggs in Resp. Tract
  - Eggs are coughed up, swallowed and passed in feces
  - Become infective in 5-7 weeks
- DH ingests infective eggs
- Larvae migrate from the intestine to the lungs in 7-10 days
- Prepatent period - about 40 days
Resp. Capillariasis – Clinical Signs

- Infection Site: Trachea and Bronchi
- Mild infection – No Clinical Signs
- Severe infection – Tracheitis and Bronchitis
  - Animal susceptible to 2nd infection
  - Deep, wheezing cough, dyspnea
  - Emaciation
- Diagnosis by Fecal Exam
- Treatment - Ivermectin

Capillaria

- Diagnosis by Fecal Exam
- Treatment - Ivermectin
- Prevention - Improve hygiene
  - Wash hands after cleaning dog or cat feces
  - Wash vegetables before eating
  - Ensure sanitary disposal of dog (and human) feces
    - Improve sewage, keep dry environment

Prevention: Improve hygiene
PROTOZOAN ZOOLOGIES

Cryptosporidiosis (Cryptosporidium parvum)
Epidemiology: Dogs can play a role of carrier and shed the organisms in the environment. Prevalence of 4 to 25% in dog feces reported. Dog to human infection not confirmed.
Diagnosis: Identification of organisms in stool specimens/tissue biopsies.
Treatment: very difficult. Spiramycin and paromomycin in humans.
Prevention: Proper water treatment. Do not eat unwashed food from gardens where animals may have defecated.

Gardiasis (Gardia duodenalis): Dogs may harbor Gardia and be shedders in the environment. Causes asymptomatic to diarrheal infection in dogs and humans.

Dermatophytes: RINGWORM

Most Common in Dogs and Humans:

Microsporum canis
Trichophyton mentagrophytes
Human Symptoms of Tinea Capitis

Lesion from microsporum canis

• Scalp: scaling, crusting, follicular inflammation, hair loss or erythema.
• Body (nails, hands, chest and legs): scaling or erythema
• Treatment: usually griseofulvin for 4 weeks (can cause medular aplasia!!)

www2.proxlab.ab.ca/bugs/webbugs/mycology/dermclin.htm
Lesions of Tinea Capitis on a 10-year infected with Trichophyton mentagrophytes

- scaling psoriatic lesions (sometimes reddish in color) on the back.
- Crusted itchy plaques on the scalp
- Thinning and brittle hair in the center of infected area.

Prevention of Tinea Capitis

- Inspection of school children’s scalp with UV light
- Daily washing of the scalp, treat with selenium sulfide shampoos
- Treatment of animals in the household of dermatophyte infection
- Education of the public of good hygiene
- Launder towels and clothes in hot water or anti-fungal agents
Cocidioidomycosis

- *Cocidioides immitis.*

- Saprozoone, Dogs and humans infected from contaminated dust and aerosol. Common in central valley of California. Endemic in the southwestern United States, parts of Mexico and South America. Incidence was 15 cases per 100,000 population in Arizona in 1995. Of persons living in areas with endemic disease, 10-50% are skin-test positive.

- Symptomatic infection (40% of cases) usually presents as influenza-like illness with fever, cough, headaches, rash, and myalgias; also can present as acute pneumonia, rarely as chronic pneumonia, or as disseminated form (affecting meninges, skin, and bone). Severe pulmonary disease may develop in HIV-infected persons.