

-Parasitic zoonoses

-Parasites live in or on another hosts and use the host for their nutrients.

Types of parasites include:

- 1- Protozoa
- 2- Helminths (worms)
- 3- Arthropods

1-Protozoan zoonoses

A. Blood and tissue protozoa

1-Toxoplasmosis

About 1/3 of world human population has been exposed to toxoplasmosis

Causative agent:

Toxoplasma gondii, crescent-shaped, small unicellular parasite of man and many mammals.

-There are 3 forms of the parasite:

1-Oocyst:

Found in cat feces only.

2-Tachyzoite (proliferative form):

3-Bradyzoite (tissue cyst):

Both bradyzoite & tachyzoite are found in raw or improperly cooked meat of infected animals.

Source and reservoir:

-Reservoirs include cats, rodents, sheep, dogs, cattle, pigs and other animals.

-Source of infection to man are meat of sheep, goat, pig, cattle, goat milk, and cat feces.

Host of *Toxoplasma gondii* includes:

1- Definitive host: Cats (wild & domestic).

2- Intermediate hosts: All animals including cats, birds and humans.

-Life cycle: include 2 phases:

1- Sexual cycle or Enteroepithelial (in cats):

2-Asexual or extraintestinal life cycle (other hosts):

Mode of Transmission:

-Ingestion of raw or improperly cooked meat, especially pork, lamb containing *Toxoplasma* cysts.

-Ingestion of unwashed fruits or vegetables that have been in contact with contaminated soil containing infected cat feces.

-Ingestion of contaminated cat feces through hand-to-mouth contact following gardening, cleaning a cat's litter box.

-Acquiring congenital infection through the placenta.

Symptoms in humans:

-Although *Toxoplasma* infection is common, it rarely produces symptoms in normal individuals.

-In immunocompetent adults toxoplasmosis, may produce flu-like symptoms, sometimes associated with lymphadenopathy which is self-limiting, and resolves after a few weeks.

Congenital toxoplasmosis:

-If a pregnant women contracts toxoplasmosis shortly before or after conception, the unborn child runs a far greater risk of congenital infection following transplacental spread.

-If the infection is acquired by mother more than 6 months prior to conception the fetus is not affected

-During the 1st trimester the risk of fetal infection is low and the fetal disease is severe.

-During the 3rd trimester the risk of fetal infection is high and the fetal disease is less severe.



-The earlier in pregnancy the disease occurs, the worse the outcome, with miscarriage, stillbirth, or visual and CNS damage, which becomes apparent after delivery, or later. The neonate may present with hydro-cephalus or retinochondritis.

Diagnosis:

-Both humeral and cell mediated immune responses are stimulated in normal individuals.

-Serological diagnosis by CFT, FAT and ELISA test.

Treatment:

-Combination of pyrimethamine and sulfamethoxazole given for a period of weeks is recommended, with addition of folic acid if required.

-Although the condition will respond to treatment, long-term therapy is necessary to prevent recurrence.

Prevention and control:

-It is recommended that all individuals in high-risk groups eat thoroughly cooked meat.

-Unpasteurized goats milk and cheese should not be eaten.

-Good food hygiene should be routine: all fruit and vegetables should be washed before being eaten and all utensils should be washed well after raw meat has been processed.

-Personal hygiene as hand washing should be as frequent as necessary to prevent infection.

-Gloves should be worn when cleaning cat litter trays. This should be done daily before any oocysts shed in the fecal matter can mature to an infectious stage.

-Pet cats belonging to risk group peoples should be kept inside and fed canned or dry foods to prevent infection from wild rodents or undercooked meat.

2-Leishmaniasis

-Leishmaniasis is a parasitic disease caused by flagellate protozoa of the family Trypanosomatidae, genus *Leishmania* and transmitted by the bite of sand flies.

-There are three main forms of leishmaniasis:

1-Cutaneous

2-Visceral

3-Mucocutaneous

-Different species of *Leishmania* cause different forms of disease.

Causative agent:

Leishmania spp.

- 1- *L. tropica*: Cutaneous leishmaniasis.
- 2- *L. donovani*: Visceral leishmaniasis.
- 3- *L. braziliensis*: Mucocutaneous leishmaniasis.

Source and Reservoir:

-Dry cutaneous and visceral forms: rats, dogs, cats and humans.

-Moist cutaneous form: humans and gerbils.

-Mucocutaneous form: primates and dogs.

Source:

Infected female sandflies which are small flies of the family Phlebotomidae (genus *Phlebotomus*).

Mode of transmission:

Bite of infected female sand fly.

Life cycle:-

The sandfly acquires the organisms during the blood meal; the amastigotes transform into flagellate promastigotes and multiply in the gut.

Disease in man:

1-Cutaneous leishmaniasis (Oriental sore or Baghdad boil):

-The incubation period is between one week and several months.

- It manifests initially as itchy erythematous lesions, which later form papules and then painless ulcers.



2-Visceral leishmaniasis (Kala-azar, Dum dum fever, black fever)

-The incubation period is generally two to six months, but it may range from 10 days to several years.

-The disease onset may be abrupt. Fever is prolonged and undulating, often with two daily peaks. Some patients experience cough, diarrhea. The disease is characterized by splenomegaly, hepatomegaly, and lymphadenopathy.

3-Mucocutaneous leishmaniasis (American leishmaniasis):

-This type occurs if a cutaneous lesion on the face spreads to involve the nose or mouth.

-The disease begins with a papular lesion on the face or extremities that may develop into a painless ulcer that seldom heals spontaneously.

Diagnosis:

-Clinical signs & symptoms.

Treatment:

Good nursing, diet, antibiotics and antimony compounds.

Control:

-Vector control.

-Reservoir control.

-Treatment of active cases.

3-Trypanosomiasis

There are 2 forms of trypanosomiasis:

a-African trypanosomiasis “African Sleeping Sickness”

b-American trypanosomiasis “Chagas disease”.

A. African Trypanosomiasis “African Sleeping Sickness”

Causative agent:

Trypanosoma brucei gambiense and *Trypanosoma brucei rhodesiense*.

Reservoirs:

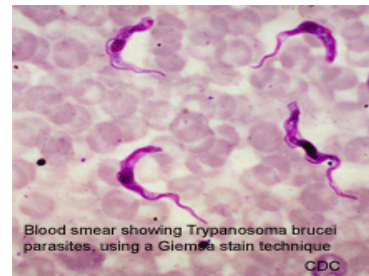
Humans, pigs, cattle and wild animals (antelope, lion).

Vector:

Tsetse fly (*Glossina* spp.).

Sings:

1- Fever, headache, pain in joints.



2- Anemia and cardiovascular problems.

3-Winterbottom's sign: swelling of the cervical lymph nodes.

4-Neurological signs: confusion, incoordination and sleeping all day. Case fatality 100% if untreated.

b. American Trypanosomiasis "Chaga's Disease"

-Primarily found in Latin America with increased infections are being detected in the United States.

Causative agent:

Trypanosoma cruzi.

Reservoir:

Cats, dogs, rodents constitute an important reservoir for human infection.

Vector:

Kissing bug (Triatomine bug).

Transmission:

T.cruzi infects its definitive host through the vector's excrement (contaminative infection).

Disease in man:

-The incubation period lasts 7 to 14 days and sometimes longer.

-The signs can range from an asymptomatic course, which is most common, to a severe or fatal disease.

-The symptoms include fever, myalgia and **Romana's sign** (unilateral eyelid swelling which seems to be mainly an allergic reaction to the bite).



Diagnosis:

1- Microscopic examination of blood film stained by Giemsa stain to show trypomastigote.

2- Serological tests as ELISA, IFAT.

Treatment of humans:

Suramin and pentamidine.

4-Babesiosis

Causative agent:

Babesia microti in USA and *B. divergens* in Europe.

Source and reservoir:

-The reservoirs for domestic animals and rodents are other infected animals, which are often healthy carriers.

Transmission:

- *B. microti* infection is transmitted in nature by the tick (*Ixodes scapularis*) and the *B. divergens* infection by *Ixodes ricinus*.

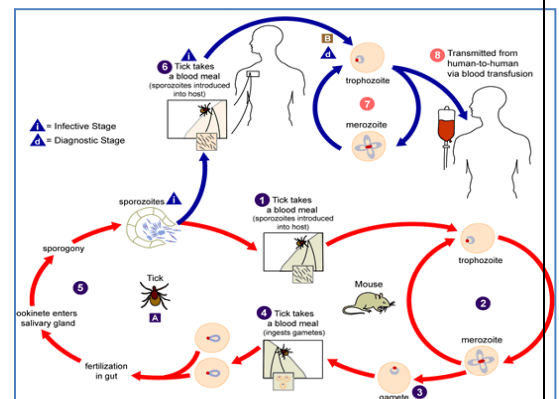
Disease in man:

-The incubation period ranges from 7 to 28 days.

-They are characterized by severe illness, often with pyrexia, chills, anemia, muscular pain, prostration, hemoglobinuria, and jaundice. The case fatality rate is about 50%.

Diagnosis:

-The clinical symptoms coincide with an epidemiological history of tick bites or visits to enzootic areas.



-Confirmed diagnoses occur when parasites are seen inside erythrocytes on Giemsa-stained thin or thick blood smears.

Treatment:

Clindamycin & quinine

Control:

-Anti-tick measures are the most effective control measure is to prevent infestation by the tick vectors.

-People living in endemic areas should control rodents inside the home and cut down vegetation surrounding the dwelling to control the presence of nymphs.

5-Sarcocystosis (Sarcosporidiosis)

Caustive agent

Sarcocystis hominis (cattle-humans).

Sarcocystis sui hominis (pigs-humans).

Transmission:

-Ingestion of beef or pork uncooked/undercooked, containing sarcocysts in muscle fibers.

-The mode of transmission to cattle or swine is through contamination of pastures or feedlots.

Source of infection:

-The source of infection for human intestinal sarcocystosis is beef or pork containing mature sarcocysts.

Disease in man:

1-Intestinal sarcocystosis: Usually asymptomatic. Clinical signs are absent except in rare cases. Diarrhea, nausea, abdominal pain, and diarrhea 3 to 6 hours after eating raw or undercooked beef containing *S. hominis*.

2-Human muscular sarcocystosis: Usually discovered during examination of muscle tissue for other reasons. Although the infection is nearly always asymptomatic, in some cases muscular weakness, muscular pain.

Diagnosis:

-Sarcocysts of *S. hominis* are microscopic in the muscles of cattle, whereas those of *S. suihominis* are macroscopic in muscles of swine.

Control:

- Hygienic disposal of human feces.

-The population should be educated about the risk of infection when raw meat is consumed, and veterinary inspection of slaughterhouses should be improved.

-Freezing of meat reduces the number of viable cyst.

-Through cooking of meat at 70°C for 15 minutes.

B. Enteric protozoa

1-Amebiasis (Amebic dysentery)

Caustive agent:

Entameba histolytica.

Source of infection:

- Fecal contaminated food & water by cysts.
- Flies & cockroaches can serve as mechanical vectors.

Mode of transmission:

Fecal-oral route.

Clinical signs:

Incubation period is 2 days-4 months.

- The symptoms range from mild abdominal discomfort with bloody mucous diarrhea, alternating with periods of constipation to acute or fatal dysentery with fever, chills, and bloody or mucous diarrhea (amebic dysentery).
- Hematogenic dissemination may carry the parasites to the liver, where they produce a focal necrosis.

Diagnosis:

- Laboratory diagnosis is based on three fecal examinations

Treatment:

Metronidazole (flagyl)

Control:

- 1-Proper disposal of human and animal wastes.
- 2-Eradication of flies and food should be covered.

3-Water sanitation with protection of water sources from fecal contamination. In endemic areas, water and food should be either boiled.

4-Limiting the use of human wastes as fertilizers.

2-Balantidiasis (Balantidiosis, balantidial dysentery)

Causative agent:

Balantidium coli.

-It is a ciliated protozoan that affects swine, primates (including humans) and, rarely guinea pigs, dogs, and rats.

-Infection acquired by ingesting cyst-containing food or water.

Reservoir hosts:

Mainly swine, probably other animals.

Transmission:

-Ingesting cyst-containing food or water: in many cases, the infection in man has been conclusively linked to contamination of water and food by feces of infected pigs or to close contact with pigs.

Disease in man:

Disease from *B. coli* in man usually affects the mucosa of the large intestine, but it can rarely invade the liver and the lung.

-In acute cases, the patient presents with severe diarrhea, often with mucus, blood, and pus in the stools.

-In chronic cases, the patient may alternate between diarrhea and constipation and suffer from abdominal pain, anemia, and cachexia. The

pathology and symptomatology for *B.coli* are similar to those associated with *Entameba histolytica*.

Diagnosis:

Fecal analysis for cysts, trophozoites.

Treatment:

Metronidazole.

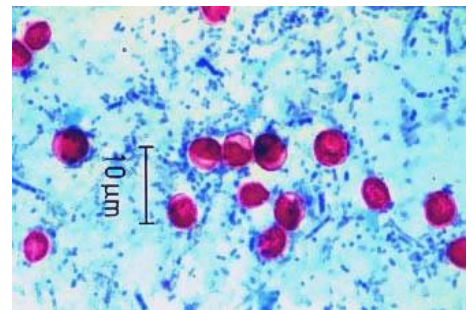
3-Cryptosporidiosis (*Cryptosporidium* infection)

Caustive agent:

- *Cryptosporidium parvum*

-The pathogenic form of *C. parvum* is the oocyst which is 4-6 um in diameter (half the size of RBC).

-*Cryptosporidium parvum* has been recognized as a human pathogen since 1976.



Hosts:

Humans, calves, dogs, rats, cats & pigs.

Mode of transmission:

-Ingestion of contaminated food & water by sporulated oocysts (thick-walled).

Source of infection:

-The sources of infection for humans are other infected people and infected cattle.

Disease in human:

- In individuals with healthy immune systems, cryptosporidiosis may be asymptomatic or may occur as a self-limiting disease.
- The illness is characterized by profuse watery diarrhea often accompanied by abdominal pain, nausea, and vomiting, low-grade fever and weight loss.
- In immunodeficient individuals, the symptoms are more severe.

Diagnosis:

- Diagnosis is confirmed by demonstrating the presence of oocysts in the patient's feces.

Control:

- Water purification and filtration: Treatment of drinking water with good filters of 1 micron filter removes around 99.9% of oocysts.
- Boiling water or drink bottled water when traveling.
- Wash vegetables & fruits.
- Cooking high-risk foods.
- Washing hands carefully before eating should also reduce the danger of infection.
- Avoid swimming in water containing effluents from sewage systems or cattle farms.

4-Giardiasis

Causative agent:

Giardia lamblia, flagellated protozoan. It has 2 forms; trophozoite and cyst.

Hosts:

Humans, dogs, cats, sheep and rats

Disease in animals:

Infected animals may be asymptomatic.

Transmission:

-Fecal- oral route (ingestion of cyst-containing food & water).

Disease in humans:

-Infection may be asymptomatic; in other patients clinical signs appear after a pre-patent period of between 1 and 4 weeks.

-The disease may present as diarrhea of either chronic or acute nature, and of either mild or severe character.

Diagnosis:

-Diagnosis has traditionally been by isolating viable cysts from faecal material of suspected sufferers.

-Detection of cysts, trophozoites, or antigens by immunodiagnostic testing, in stool specimens or duodenal fluid.

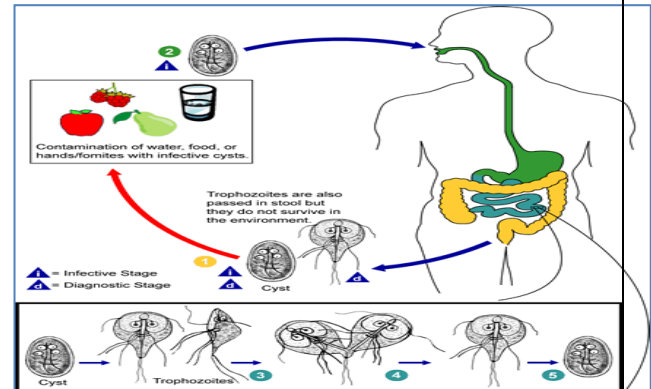
Treatment:

Metronidazole is the treatment of choice for giardiasis.

-Chronic cases are often requiring repeated treatment courses to achieve elimination of the protozoan.

Prevention:

-Avoid drinking water or consuming foods that have not been washed in clean water.



-Normal hygiene routines of washing hands after defecating and before handling food prevent spread.

2-Helminths

A-Trematode zoonoses (flukes)

-Adult flukes are leaf-shaped flatworms. Flukes are hermaphroditic except for blood flukes, which are bisexual. The life cycle includes a snail intermediate host.

-Classified according to their habitat into:

- 1- Blood flukes: *Schistosoma*.
- 2- Liver flukes: *Fasciola*, *Clonorchis sinensis* and *Opisthorchis felineus*
- 3- Lung flukes: *Paragonimus westermani*.
- 4- Intestinal flukes: *Fasciolopsis buski* and *Heterophyes heterophyes*.

While the details vary with each species, the general life cycle stages are as follows:

Egg: discharged either in water or in intestine of definitive host.

Miracidium: free-living motile form, covered with cilia, which settles in the mollusc to become a sporocyst.

Sporocyst: an elongated sac that produces either rediae or more sporocysts.

Redia: a larval form with an oral sucker. It will produce either more rediae, or cercariae.

Cercaria: the larval form of the parasite, developed within the germinal cells of the sporocyst or redia.

Metacercaria: a cercaria encysted and resting.

Adult: the fully developed mature stage, capable of sexual reproduction.

1-Human fascioliasis

Causative agent:

F. gigantica, F. hepatica .

Distribution:

Worldwide.

Habitat:

Bile duct

Definitive host:

Herbivorous animals (sheep & cattle) and humans.

-*Rattus rattus* can play an important role as reservoir and participate in the geographical diffusion of the disease.

Intermediate host:

Snails are intermediate hosts.

- Numerous species of the genus *Lymnaea* (*L. cailliaudi* and *L. truncatula*).
- Biomphalaria alexandrina* was also identified as snail intermediate hosts in Egypt.

Sources of infection:

- Freshwater plant as watercress, lettuce, radish...etc
- Water either directly by drinking or indirectly by contaminating vegetables or kitchen utensils.
- Raw fresh livers infected with immature flukes.

Disease in man:

-The course of infection passes through three phases:

- 1-The acute phase.
- 2- The chronic phase.
- 3-The obstructive phase.

-Pathology and clinical manifestations are related to the phase.

1-The acute phase:

- It persists for several weeks to months (3-4 months).
- Severe pathology results from parasite migration and destruction of parenchymal tissue, causing toxic and allergic reactions.
- Acute symptoms include prolonged high fever, hepatomegaly and abdominal pain in the right hypochondrium.
- Peripheral eosinophilia, up to 80% and anaemia.

2-The chronic phase:

- The life span of the parasite is 10-13 years.
- Pathology tends to be mild.
- Few gastrointestinal symptoms, intermittent fever with persistent prominent eosinophilia.
- Recurrences of the acute signs and symptoms and recurrent cholangitis.

3-Obstructive phase:

Coincides with epithelial changes in the bile ducts due to irritation of the epithelium by the spines.

- Severe pathology occurs in the form of epithelial hyperplasia & proliferation, periductal inflammation then fibrosis and even calcification leading to partial obstruction.
- Recurrent cholangitis and cholecystitis.

Ectopic fascioliasis:

May occur during any of the three phases of the disease but is most common during the acute phase. It may be due to:

1. Juveniles that migrate out of the intestine but do not locate in the liver so they form ectopic lesions in many abdominal tissues.
2. Juveniles that enter the portal circulation, so distributed throughout the body.

- The focal lesions in the ectopic sites may be masses, abscesses, migration tracks or hemorrhage. These are often misdiagnosed as malignant ulcers or tumors.

-Exploratory abdominal surgery may be needed to make the diagnosis.

Complications:

1-Liver abscess and haematoma.

2-Biliary cirrhosis: due to the peri-ductal fibrosis.

3-Obstructive jaundice: Obstruction of the common bile duct by *Fasciola* adults.

N.B. Halzoun:

A special form of fascioliasis has been reported in some countries as the inhabitant's people eat raw sheep or goat's liver.

Diagnosis:

1-Clinical diagnosis + the haematological and biochemical findings:

Hepatomegaly, fever, anaemia and marked eosinophilia are highly suggestive of the disease.

-Ectopic localization of the parasite may cause a confusing clinical presentation.

2- Parasitologic diagnosis:

-Eggs are not excreted during the invasive stage of infection when many patients present with severe symptoms.

-Sometimes eggs are undetectable during the chronic phase.

3-Immunodiagnosis:

Treatment:

-Curative treatment is essential in human fascioliasis to control symptoms and to avoid the hepatobiliary complications.

-Several drugs have been used. The drug of choice is triclabendazole.

Prevention and control:

1-Periodic examination and treatment of livestock animals.

2-Control of the snail vector.

3-Health education, people must be aware of how infection might occur.

4-Using either 6% vinegar (100 ml/l) or potassium permanganate (24 mg/l) for 5 to 10 minutes for cleaning freshly eaten vegetables.

2-Blood flukes

Schistosomiasis (Bilharziasis)

Schistosomiasis is one of the main human parasitoses and is very important to public health because of its debilitating effect on people throughout large areas of the world.

Causative agent:

Schistosoma mansoni, *S. japonicum*, and *S. haematobium*, which measure 0.5-2.5 cm in length and live in pairs inside blood vessels.

Geographical distribution:

-Worldwide schistosomiasis is endemic in number of developing countries.

-Direct mortality is relatively low, but the infection poses a public health problem because of the chronic pathology and disability that it produces.

-Despite control efforts in a number of countries millions of people are still infected.

Habitate:

Veins that drain abdominal organs of the hosts.

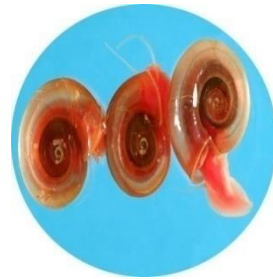
Hosts:

1-Definitive hosts:

Humans, monkeys, baboons, pigs, rodents, dogs and cattle.

2- Intermediate host:

Bolinus & biomphalaria snails.



Life cycle:

-Persistence of schistosomiasis depends on the presence of an appropriate snail as an intermediate host.

-Eggs excreted in stool (*S. mansoni* and *S. japonicum*) or urine (*S. haematobium*) into fresh water hatch into motile miracidia, which infect snails.

-After development in the snails, cercariae emerge and penetrate the skin of humans encountered in the water.

-The cercariae pass through lungs to liver where they mature, mate and pass down into mesenteric or vescical venules to begin egg production.

-Communicability lasts as long as live eggs are excreted in the urine and feces.

-Adult worms of the *S. mansoni* species have been documented to live as long as 26 years in the human host.

-Thus, schistosomiasis can be diagnosed in patients many years after they have left the endemic areas.

-The incubation period is variable but is approximately 8 weeks for *S. haematobium* and 4 weeks for *S. mansoni* and *S. japonicum*.

Mode of transmission:

-Penetration of cercaria into skin of the host.

-Cercaria is infective for only a few hours.

-Schistosomiasis is an occupational disease of farmers and fishermen who work in fish culture ponds and rivers.

Clinical signs:

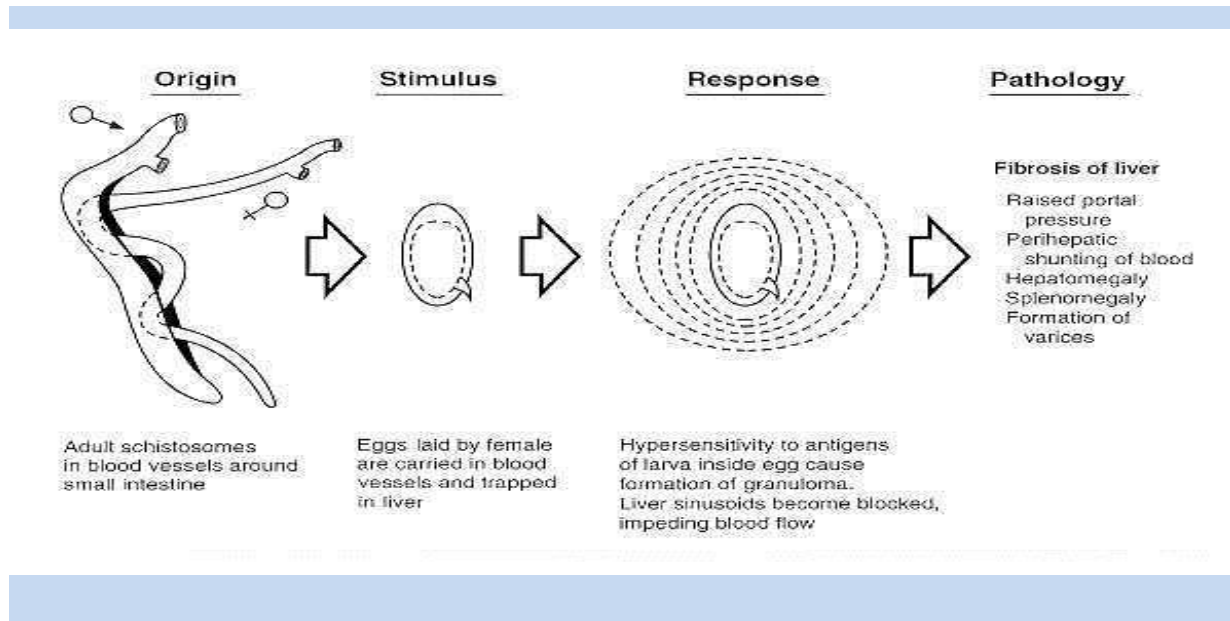
-The symptoms of schistosomiasis include:

1-The first phase (dermatitis): due to the penetration of cercariae. It is manifested by a cutaneous allergy to the parasite's products. At first there are petechiae with edema and purities; these are followed by urticaria, which can become vesicular and last from 36 hours to 10 days.

2-The second phase: Mostly there are no clinical manifestations. In case of massive infections there may be fever, diarrhea, and abdominal pain.

3-The third phase (Schistosomiasis) or chronic or granulomatous phase: reflects the tissue response to the deposition of eggs. The antigens of the eggs that are retained in the tissues generate a cell-mediated immune

response that forms granulomas around the eggs. In *S. mansoni* infection, the main lesions are found in the intestinal wall. Over time, they spread to the liver and produce interlobular fibrosis and portal hypertension, ascites, and splenomegaly.



Diagnosis of schistosomiasis:

1-Parasitologic examination of urine in case of *S. haematobium* or stool in case of *S. mansoni*.

Control measures:

The key elements of control measures depend on:

- Treatment of infected populations.
- Sanitary disposal of human waste.
- Education about the source of infection.

- Elimination of the intermediate snail host is difficult to achieve in most areas.

3-Lung fluke **(Paragonimiasis)**

Causative agent:

Paragonimus westermani (*P. philippinensis*): it parasitizes wild and domestic carnivores, swine, rodents, birds.

-*Paragonimus* is found throughout the world.

Source of infection and mode of transmission:

-The source of *Paragonimus* infection for man and other definitive hosts is freshwater crabs and crayfish containing parasite metacercariae.

-Transmission results from the ingestion of raw or undercooked crustaceans.

Disease in man:

-*Paragonimus* trematodes reside mainly in the lungs.

-A long time elapses between the ingestion of metacercariae and the appearance of symptoms, though the duration of this period is variable.

-The parasites can cause damage as they migrate toward the lungs and seek a mate in the pleural cavity, while they are encysted in the lungs, and sometimes when they become lodged in ectopic sites.

-During this phase, there can be abdominal pain, fever, and diarrhea.

-The prominent symptoms of pulmonary paragonimiasis are chronic productive cough, thoracic pain, and blood-tinged viscous sputum and sometimes fever.

-Small numbers of parasites in the lungs do not significantly affect the health of the patient and do not interfere with routine activity.

-The most frequent and serious ectopic localization of *P. westermani* is the brain.

Control:

Control efforts should be directed to cut the infection cycle by the following means:

a) Education of people to prevent the consumption of raw or undercooked crabs or crayfish.

b) Mass treatment of the population to reduce the reservoir of infection.

c) Sanitary disposal of sputum and fecal matter to prevent the contamination of rivers.

d) Controlling snails with molluscicides in areas where this approach is feasible.

4-Trematodes transmitted through fish

A-Clonorchiasis (Chinese liver fluke disease)

Caustive agent:

Clonorchis sinensis is a small trematode measuring 12-20 mm. long and 3-5 mm. wide, with a reddish, translucent body. It lives in the bile ducts of humans, cats, dogs and other species of fish-eating mammals.

-The parasite requires two intermediate hosts to complete its life cycle.

1-The first is any of several operculate aquatic snails, such as species of *Bulinus*.

2-The second intermediate host is any of more than 100 species of freshwater fish (often members of the family Cyprinidae).

Mode of transmission:

Consumption of raw or undercooked fish.

Reservoir:

-The reservoirs of the parasite are humans, cats, dogs several other fish-eating mammals.

Disease in man:

-The symptoms depend on the number of parasites, the length of time the infection has persisted, and whether continuous reinfections have occurred.

-In mild infection there are no manifestations of disease. When the infection is more intense and of longer duration, the patient may exhibit loss of appetite, diarrhea, and a sensation of intra-abdominal pressure, fever, and eosinophilia.

-In the heaviest infections, there may be enlargement and tenderness of the liver, obstruction of the bile ducts, and even cirrhosis, with edema and ascites.

Diagnosis:

-Specific diagnosis of the infection is made by finding the parasite's eggs in fecal matter.

-Use of ELISA showed high specificity and sensitivity.

Control:

-The most effective control measure is by avoid eating undercooked fish.

-Freezing or salting fish is not a very effective control measure because the metacercariae remain infective for 10 to 18 days at -12°C, for 3 to 7 days at -20°C.

2-Opisthorchis felinus (Cat-liver fluke)

Causative agent:

-The agents of this disease are *Opisthorchis viverrini* and *O. felinus* are trematodes that lodge in the bile ducts of humans, cats, dogs.

-The development cycle of *Opisthorchis* is similar to that of *Clonorchis*, requiring two intermediate hosts: aquatic snails are the first, and various species of freshwater fish are the second.

-The definitive hosts of this species are man, dogs, domestic and wild cats, and other animals that eat fish or fish scraps.

Mode of transmission:

-Man and other definitive hosts become infected by eating raw or undercooked fish containing metacercariae.

Disease in man:

The symptoms of the disease are similar to that caused by *Clonorchis sinensis* and depend on both the parasite burden and the duration of the infection.

Diagnosis:

-Laboratory diagnosis is based on demonstrating the presence of parasite eggs in feces by sedimentation techniques.

4-Intestinal fluke

a-Heterophyasis

Causative agent:

-*Heterophyes heterophyes* is a very small pyriform trematode measuring 1-1.7 mm long by 0.3-0.4 mm wide that lives in the small intestine of humans, cats, dogs and other fish-eating mammals or birds.

Source and mode of transmission:

-The source of infection for man, other mammals is fish (from fresh, brackish, or salt water) infected with the parasite metacercariae.

- Eating raw or undercooked fish is the main mode of the human infection.

Disease in man:

-Mild infections are usually asymptomatic.

-Irritation of the intestinal mucosa with excessive secretion of mucus, superficial necrosis of the epithelium, chronic diarrhea, colic, and nausea. Eggs of the parasite sometimes enter the blood stream and produce granulomatous foci in various tissues and organs, including the myocardium and brain.

Diagnosis:

-Diagnosis is based on the microscopic observation of parasite eggs in fecal matter.

-The species can be identified by examining the adult trematodes following anthelmintic treatment.

Control:

- Thorough cooking of fish and the proper disposal of excreta.

-Metacercariae survives up to for several days if they are marinated in vinegar.

-Dogs and cats should not be fed raw fish or scraps containing raw fish because they can become infected, contaminate the environment, and thus maintain the infection cycle.

B-Cestode zoonoses

Common features of class Cestoda:

1-Adult worm is flattened ribbon-like, without body cavity.

2-They are hermaphroditic.

3-Digestive tract is absent. Nutrition is absorbed by villi of body surface.

1-Taenia infection (Taeniasis & cysticercosis)

Taeniasis: It is the intestinal infection of man with the adult tapeworm *T. saginata* & *T. solium*.

Cysticercosis: It is the presence of larval stage of *T. solium* (*Cysticercus cellulosae*) in different tissues & organs in man.

Geographic Distribution:

Cosmopolitan, mostly common where poor sanitation and no inspection of meat occur.

Causative agent:

❖ *T. saginata* (beef tapeworm).

❖ *T. solium* (pork tapeworm).

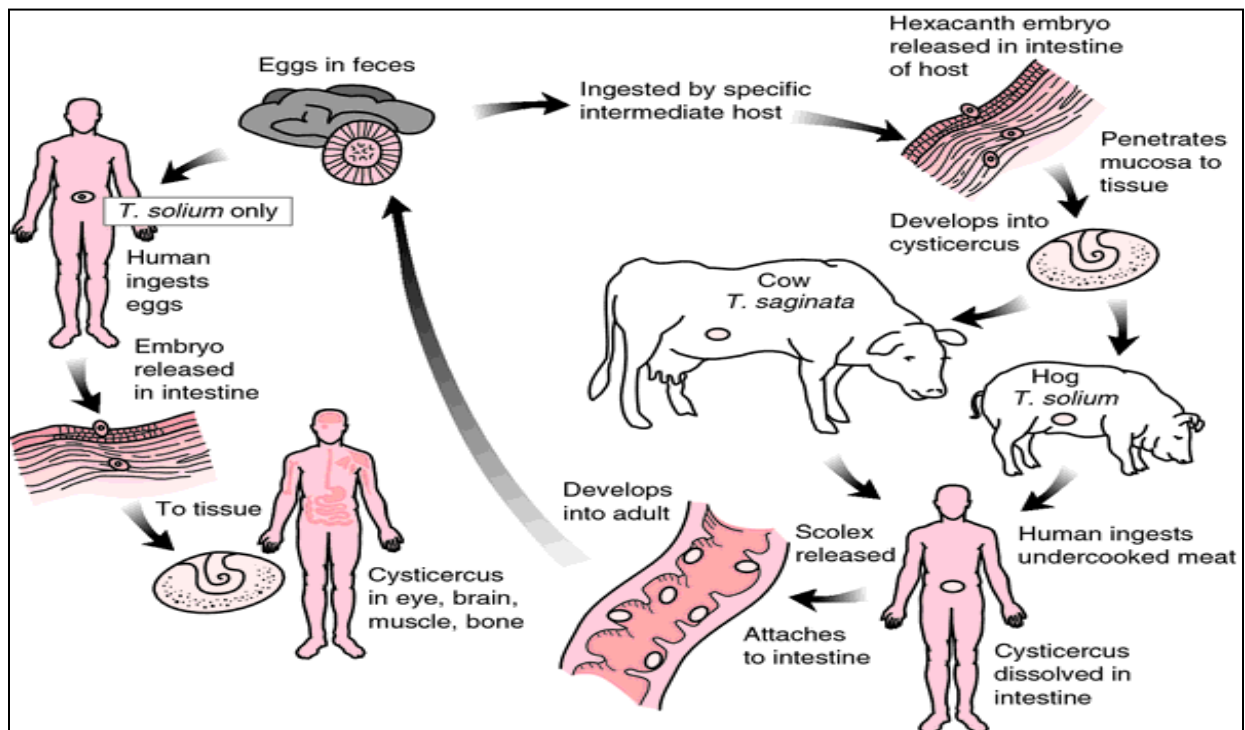
Transmission:

Taeniasis: Ingestion of undercooked beef & pork containing cysticerci.

Cysticercosis: 1-Ingestion of raw food containing eggs.

2-Autoinfection: either external or internal.

Life cycle:



Disease in humans:

Signs of taeniasis:

-There are few symptoms associated with the adult worm, except slight irritation of the site of attachment or abdominal pain with feel of hunger, loss of weight and general condition.

-Diarrhoea and/or constipation.

Cysticercosis:

-When the cysts are cited in the brain, complications, including neurological disturbances. The intensity and type of symptoms seen in cases of neurocysticercosis depend upon the number of lesions present and their location, size.

Diagnosis:

-Isolation of eggs or proglottids from the stool.

Treatment:

-Niclosamide or praziquantel. They are solely active against adult worms and do not kill larval stages.

-In case of cysticercosis. Usually surgical removal of the cysts is advised in humans with administration of anthelmintics.

Prevention:

- Strict system of meat inspection.

-Suspect meat or meat products should be thoroughly cooked.

-Suspect carcasses or meat should be frozen for at least 3 weeks to kill any larvae.

-Hygienic disposal of human sewage is important in breaking the infective cycle.

2-Diphyllobothriasis

(Broad tapeworm infection, Fish tapeworm infection)

Causative agent:

Various species of the genus *Diphyllobothrium*, most important one is *Diphyllobothrium latum* (Broad fish tapeworm).

Geographical distribution:

D. latum is a cosmopolitan species found in the temperate zones.

Source of infection and mode of transmission:

- Feces of humans and other fish-eating mammals.
- Contamination of water with feces containing *D. latum* eggs allows the initial infection of copepods and subsequent infection of fish.
- Humans become infected by eating raw fish, lightly salted, or smoked without sufficient heat.

Disease in man:

- . In most cases, the infection is asymptomatic.
- When symptoms occur, they generally consist of diarrhea, epigastric pain, nausea, and vomiting
- Some patients who harbor a large number of parasites may suffer mechanical obstruction of the intestine.

Control:

Prevention of the infection in humans is based on the following:

- Educating the population to avoid eating raw or undercooked fish and contaminating the lakes with their feces.
- Treating of infected persons to prevent contamination of the environment.
- Cooking fish to 56 °C for 5 minutes or freezing it to -10 °C for 48 hours to kill the plerocercoids.

3-Echinococcosis & Hydatid disease

Causative agent:

3 known species of *Echinococcus* are medically important

-*Echinococcus granulosus*

-*Echinococcus multilocularis*

-*Echinococcus vogeli*

-*Echinococcus granulosus* causes cystic echinococcosis, the most commonly seen form of the disease. Another species, *E. multilocularis*, causes alveolar echinococcosis.

Transmission:

Human infection follows consumption of food or water contaminated with viable eggs from dog feces.

Life cycle:

Infective stage:

Egg found in dog feces (resembles *Taenia* eggs).

Disease in man:

-Vary by size and site of cyst. Usually no symptoms until cyst becomes enlarged.

-Clinical signs and detection follow abdominal swelling and pressure on other internal organs or bile duct obstruction with associated nausea and pain. The retaining membrane may rupture into the abdomen, pericardium or pleural cavity with the possibility of anaphylactic shock .

-Primary cysts may also form in other sites, with the lungs, kidneys, CNS and bone marrow being.

-Lung cysts are usually asymptomatic until they become large enough to block airways or they rupture. Persistent dry cough, pain or coughing of blood may occur.

-Cysts in the CNS cause symptoms with epileptiform fits.

Diagnosis:

Diagnosis is usually made by radiographic images of lungs and liver, CT scan and MRI.

Treatment:

-Praziquantel kills adults.

-PAIR technique.

-Treatment traditionally was surgical to remove the cyst or cysts and the contents.

Prevention & control:

-Prevention strategies include the regular de-worming of dogs.

-Stray dogs should be controlled .

-Feeding dogs with sheep offal or infected meat should be avoided.

-Preventing human infection depends on implementation of strict hygiene measures after handling animals and wash fruits before eating.

4-Hymenolepiasis

4.1. *Hymenolepis nana*

Causative agents:

Hymenolepis nana (Dwarf tapeworm).

It is most common tapeworm of humans in the world.

Definitive host:

Humans and rodents.

Intermediate host:

Larval and adult beetles (but optional).

-Larval stage, cysticeroid, can develop in D.H. if it eats the eggs.

Mode of transmission:

-Ingestion of infected beetle.

-Ingestion of food contaminated with feces (human or rodent).

-As the human act as reservoir of *H. nana* so human infection occurs by the fecal-oral route.

Disease in man:

-Generally no symptoms because worm is so small (about 40 mm). Heavy infections can result in verminous intoxication.

-The most important symptoms in the children infected by *H. nana* were abdominal pain, decreased appetite, weight loss and flatulence.

Diagnosis:

-Specific diagnosis is made by detecting the characteristic eggs in the feces.

Treatment:

Praziquantel.

Prevention:

-Rodent control.

-Proper disposal of human sewage.

4.2. Hymenolepis diminuta

Definitive Host:

H. diminuta is a cestode of rodents, in particular rats, and rarely man.

-Human infections are uncommon.

Intermediate Host:

Grain beetles & rat fleas (required).

Geographic distribution:

Cosmopolitan.

Mode of transmission :

-The natural reservoirs of *H. diminuta* are rodents, mainly rats. Man is infected only accidentally by ingesting insects (beetle & rat flea) infected with the cysticercoid, particularly insects that contaminate precooked cereals.

Disease in man:

Usually asymptomatic.

Diagnosis:

Specific diagnosis is made by detecting the characteristic eggs in the feces.

Treatment:

Praziquantel.

Prevention:

-Rodent control.

5-Dipylidiasis
(Dipylidiosis, Dog tapeworm infection)

Causative agents:

Dipylidium caninum is a cestode 10 to 70 cm long and 3 mm at its widest part, with 60 to 175 proglottids;

Definitive host:

Dog, cat, and some wild felids and canids.

Intermediate host:

Dog flea as (*Ctenocephalides canis*) and cat fleas (*C. felis*). The human flea (*Pulex irritans*) can occasionally serve as intermediate hosts.

Geographic Distribution:

Cosmopolitan.

Mode of transmission:

-Man is infected by ingesting fleas infected with cysticercoids of *D. caninum*.

Disease in man:

-The symptoms consists of digestive disorders, such as diarrhea, loss of appetite, and insomnia.

Diagnosis:

-Diagnosis is based on microscopic observation of the gravid proglottids.

Control:

Control measures consist of flea and cestodes removal from pets.

C-Nematode Zoonoses (Nematodiasis)

1-Trichinellosis (Trichinosis)

Causative agent:

Trichinosis caused by a tissue nematode of the genus *Trichinella*, mostly caused by *T. spiralis*.

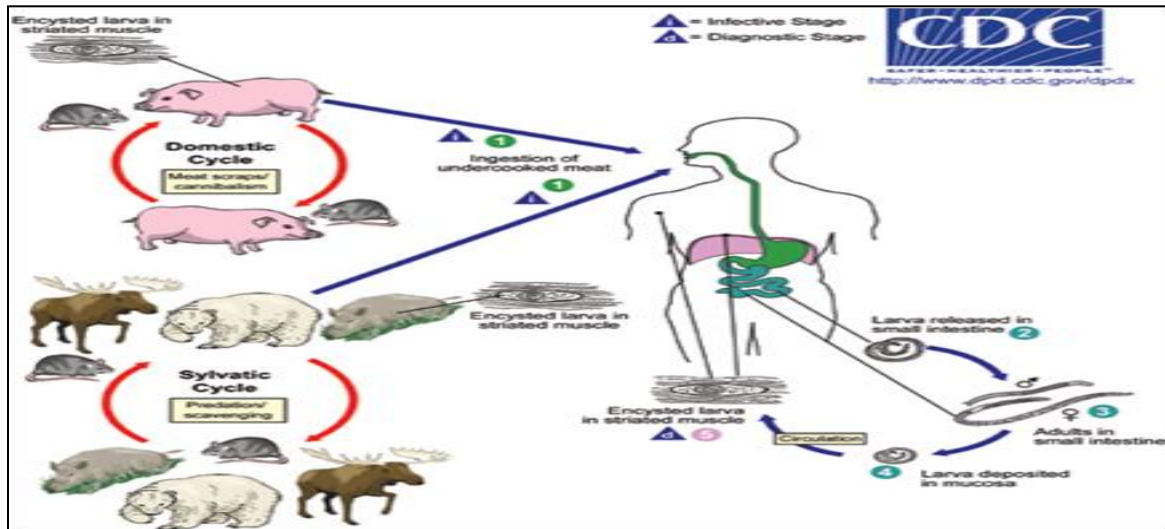
Reservoir:

The parasite is normally associated with pigs and dogs, rats and cats may also act as reservoirs.

Transmission:

Infection in humans follows the ingestion of infected animal tissue.

Life cycle:



Disease in humans:

- The severity of symptoms directly related to the number of viable encysted larvae ingested.
- The mildest cases are usually subclinical, with a small amount of muscle pain being present.
- In heavy infestations a sudden onset of muscle pain, fever and swelling of the eyelids, followed by haemorrhages in the retina, conjunctiva and mouth.
- The most commonly predilection sites for larvae are the diaphragm, ribs, biceps, larynx, tongue and jaw or neck muscles.

Diagnosis:

- Diagnosis is made using serological testing or muscle biopsy (ELISA and PCR methods can be used successfully).

Treatment:

Most cases resolve spontaneously, so symptomatic treatment and support are necessary.

Prevention:

Ensuring that all offal fed to pigs has been thoroughly heated at greater than 77°C that prevents infection by ingestion of any infected animal tissue.

-Rats should be controlled in pig units.

2-Cutaneous Larva Migrans /CLM (Creeping eruption)

Caustive agent:

-The hookworms, *Anclystoma braziliense*, *A. caninum*.

Disease in man:

-Due to the nature of the infection and its etiology, it is often seen in travelers returning from beach holidays specially in children, because their skins are softer especially on their feet.

-Clinical signs commence after penetration of the skin by the infective third-stage larvae, usually as a result of walking on contaminated sand or soil in bare feet.

-Itchy reddened spots appear at the site of entry. After 2-3 days the larvae start to migrate through the layers of the skin, leaving a raised red and itchy track with localized swelling.

Treatment:

-Thiabendazole is currently considered the agent of choice in the treatment of cutaneous larva migrans (CLM).

-Use of any of the broad-spectrum antihistamines will help control itching.

-Use of antibiotic in secondary infection.

Prevention:

-Wearing shoes on ground that could be contaminated with dog or cat feces is recommended.

-The exclusion of dogs from recreation areas frequented by children.

-Dogs and cats should be regularly wormed to eliminate the adult parasite.

3-Visceral Larva Migrans / VLM

(Toxocariasis)

Causative Agent:

Toxocara canis, *Toxocara cati* and *Toxocara vitulorum*.

Transmission:

-*T. canis* is mainly transmitted from dog to dog and from dog to human by the ingestion of material infected with encysted eggs.

Disease in humans:

1-Visceral larva migrans:

-Migration can result in multiple abscesses, hepatomegaly and pneumonitis. Symptoms include coughing, nausea, vomiting and fever, wheezing, splenomegaly and lymphadenopathy.

2-Ocular larva migrans:

-Ocular larva migrans is a rare form of visceral larva migrans that can cause blindness.

-Sufferers can experience permanent or partial loss of vision.

Treatment:

Treatment relies on anthelmintic therapy with mebendazole and ivermectin. Corticosteroids, antibiotics, antihistamines and analgesics can be used for symptomatic relief.

Prevention:

-Through hand washing well with soap after playing with pets and after outdoor activities, especially before eating.

-Children should be taught not to eat soil or sand.

-Regular periodic worming treatment of puppies, kittens, pregnant and nursing dogs and cats will prevent acquisition and shedding of the parasite.

4-Ascariasis

Causative agent:

-*Ascaris lumbricoides* is usually deemed to be a human-to-human parasite transmitted by the faecal-oral route.

-*A. suum* is normally found in pigs. The infection is more common in areas where sanitation or hygiene routines are inadequate.

Transmission:

-Infection can be by ingestion of vegetables or salad containing viable eggs adhering to it.

-The eggs hatch in the duodenum and migrate through the gut wall and then via the blood to the lungs.

Disease in humans:

-The condition may be asymptomatic or may be generalized symptoms of fever and headache.

-Larvae can cause pulmonary symptoms, with asthma, pneumonia, cough and wheeze. The larvae are usually coughed up or migrate up the bronchi and are then swallowed again.

-Once they return to the gut the larvae will pass through their remaining larval stages. Adults will breed in the gut; the female worm is larger than the male.

-The symptoms may include gastric cramps, vomiting and diarrhea, pancreatitis, intestinal obstruction and malnutrition with weight loss.

-The whole cycle from egg to adult takes about 2 months. Eggs passed in the feces become infective after 2 weeks. Some larvae may not migrate directly to the lungs and can cause complications arising from their travels or residence in the brain, eyes, liver or kidneys. The worm and its larva cause sensitization.

Diagnosis:

Eggs may be identified in the stool; larvae or adults may be seen in feces or recovered from the throat, mouth or nose. Larvae may also be present in sputum.

Treatment:

-The condition is usually treated with anthelmintics.

-Physical removal may be possible during endoscopic investigations.

Prevention:

-Vegetables and salads should be thoroughly washed before consumption to reduce or remove any contamination.

-Pig manure should not be used as a fertilizer or slurry on field, where produce is being actively grown.

5-Anisakiasis **(Herring worm disease)**

Causative agent:

Anisakis simplex (herring worm).

Source of and Mode of Transmission:

The main source of infection for man is marine fish, many species of which are highly parasitized.

-Human cases are caused by consuming raw, lightly salted, or smoked fish.

Disease in Human:

-The main symptoms consisted of mild epigastric pain and nausea beginning when the infected fish was ingested and lasting up to 20 hours; in about 2 weeks, the parasite was expelled by coughing or vomiting or was found in the mouth.

Diagnosis:

-Direct diagnosis by examination of the parasite is the preferred.

-In 50% to 70% of gastric cases, the parasite can be visualized and recovered by endoscopy.

-In colonic anisakiasis, it is difficult to see the parasite by endoscopy but the lesions and X-rays are very useful for diagnosis.

Control:

-Avoid eating raw fish. Most species of anisakids that are dangerous for humans die when exposed to temperatures of -20°C for 24 hours or 60 °C for one minute.

-It is important to eviscerate fish immediately after they are caught to prevent the *Anisakis* larvae from passing from the intestine to the muscle.

6-Capillariasis

6.1. Intestinal capillariasis

6.2. Hepatic capillariasis

6.3. Pulmonary capillariasis

Caustive agent:

The agents of intestinal, hepatic, and pulmonary capillariasis are the nematodes *Capitlaria philippinensis*, *C. hepatica* and *C. aerophila*, respectively.

Source of infection and mode of transmission:

1-Man is the only known definitive host of *C. philippinensis*. But there are epidemiological reasons to suspect that the definitive natural hosts are piscivorous birds and that the intermediate hosts are fish in clean or contaminated waters.

-The main source of infection for humans is the infected fish, and the mode of infection is the ingestion of undercooked fish.

-Direct person-to-person transmission may also occur.

2-The main reservoir of *C. hepatica* is rodents. The infection is transmitted by ingestion of embryonated eggs that have been released from the liver of rodents and disseminated through the external environment by carnivores.

-For man, the source of direct infection is the soil, and the source of indirect infection is contaminated hands, food or water.

3-The source of *C. aerophila* infection for man and animals is the soil, where the eggs deposited with the feces of animals continue their incubation and the larvae reach the infective stage. Larvae can remain viable inside the eggs for a year or more.

-Children probably acquire the infection by ingesting dirt or water and food contaminated with eggs.

Disease in man:

1-Intestinal capillariasis:

Caused by *C. philippinensis*.

Most patients are 20-45 years of age, males more infected than the female.

- The disease begins with insignificant symptoms such as abdominal pains. Intermittent diarrhea, which becomes persistent as the disease progresses, begins in two or three weeks, along with marked weight loss and cachexia.
- Death occurs as a result of heart failure a few weeks or months after the onset of symptoms.

2-Hepatic capillariasis:

Caused by *C. hepatica*, which reaches maturity and begins to produce eggs in the liver.

- The disease is serious and frequently fatal. A prominent sign is hepatomegaly; high morning fever, nausea, vomiting, diarrhea or constipation, abdominal distension, edema of the extremities and splenomegaly.

3-Pulmonary capillariasis:

Caused by *C. aerophila* which leads to coughing, mucoid or sometimes blood-tinged expectoration, fever, dyspnea, and moderate eosinophilia.

Diagnosis:

- Diagnosis of intestinal capillariasis depends on symptoms.
- Coprologic examination confirms the diagnosis.
- A specific diagnosis of hepatic capillariasis is suspected from the presence of fever, hepatomegaly and eosinophilia in a patient in an endemic area.
- Confirmation can be obtained only from liver biopsy and identification of the parasite or its eggs.
- Diagnosis of pulmonary capillariasis can be obtained by confirmation of the presence of eosinophils and the typical eggs in the sputum, or by biopsy of pulmonary tissue.

Control:

- In endemic areas, intestinal capillariasis can be controlled by preventing the eating of raw or undercooked fish.
- Hygienic disposal of human excreta.
- Hepatic capillariasis individual prevention consists of carefully washing suspected foods and avoiding eating them raw; and washing hands carefully before eating.

7-Zoonotic Filariasis

8.1. Pulmonary Dirofilariasis

8.2. Subcutaneous dirofilariasis

8.3. Brugian filariasis

8.1. Pulmonary dirofilariasis (Dog heartworm)

Cause:

Dirofilaria immitis, nematode that can kill dogs.

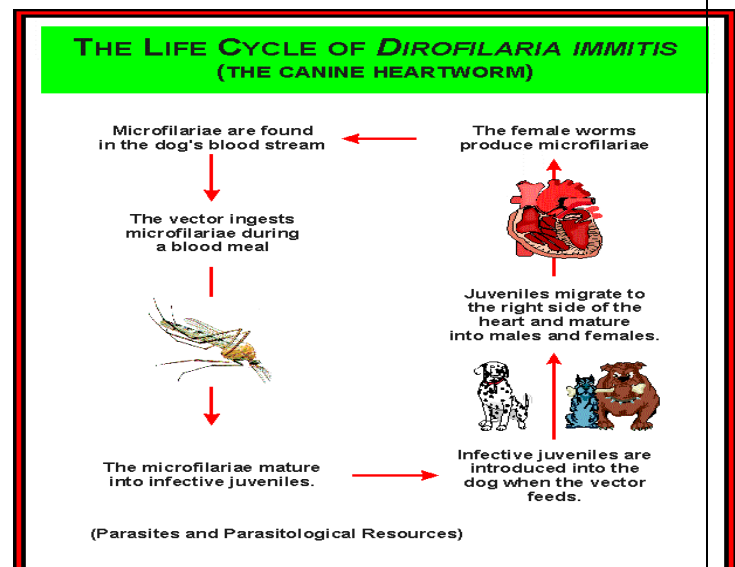
-It often causes pulmonary or cutaneous symptoms and is transmitted by a variety of mosquitoes.

-In man, the parasite begins its cycle from the subcutaneous tissue, reaches the heart and dies, and is carried in the

blood stream to the lung, where it forms a thrombus. The parasites are usually found dead, forming a 1-4 cm nodule in the lung.

8.2. Subcutaneous Dirofilariasis:

Cause:



Dirofilaria repens.

-The lesion is generally a subcutaneous nodule or submucosal swelling which may be nodular. The most frequent localizations are the head, chest wall, upper extremities and occasionally the conjunctiva.

8.3. Brugian filariasis (Elephantiasis)

Cause:

Brugia malayi.

-The main symptoms of filariases due to *B. malayi* are lymphadenopathies, lymphangitis, and high eosinophilia.

-Attacks of lymphadenopathy lasting several days occur at irregular intervals, with fever, malaise, nausea and swelling of one leg.

-In advanced cases, elephantiasis of the lower extremities may occur due to obstruction of the lymphatic circulation.

Diagnosis:

-*B.malayi* infection can be diagnosed in man when microfilariae are detected in the patient's blood.

-The most common techniques are the blood smear stained with Giemsa stain.

3-Arthropods

1-Scabies

-

Causative agent:

1- *Sarcoptic scabiei*

a- *var. hominis*

b- *var. canis*

c- *var. ovis*

2- *Ornithonyssus bacoti* (rodents)

3- *Dermanyssus gallinae* (fowl mite)

Transmission:

-Infection results from direct contact and also fomite spread.

Disease in humans:

-After zoonotic infection, the mite does not burrow under the skin surface and is believed to cause itching and an associated rash.

-Lesion presents with blisters, red papules and crusting. It appears rapidly, intensely itchy, and when the lesions have been scratched, crusting may be seen.

2-Specific myiasis (Screwworm infestation)

Myiasis: The infestation of live vertebrate animals by the larvae of dipterous flies which feed on living or dead tissue.

Causative agent:

Larva of *Cochliomyia hominivorax*.

-*Cochliomyia* is a genus in the family Calliphoridae, known as blowflies, in the order Diptera.

-*Cochliomyia hominivorax* is known as the screw worm because of the screw shape of their larvae which feed on living tissue producing deep,

pocket-like lesions in the skin, which can be very damaging to the animal host.

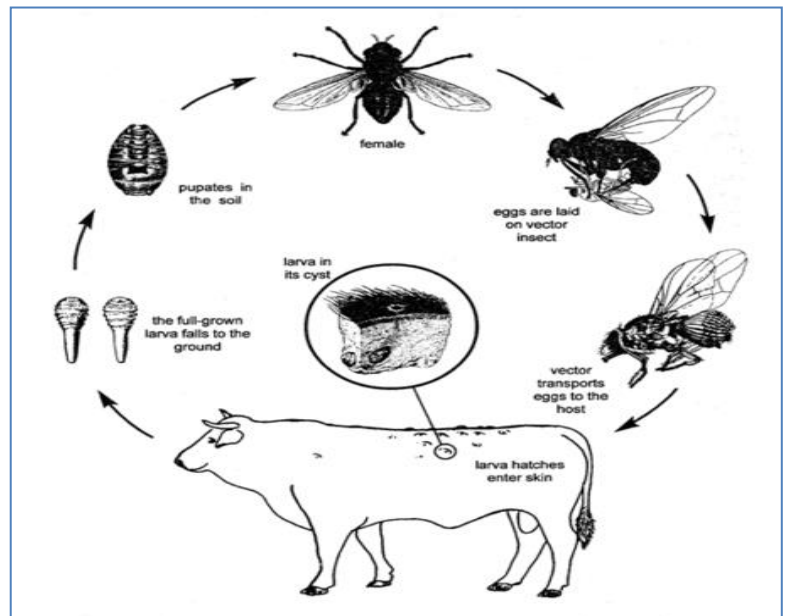
-Most fly strikes occur during the farming processes as branding, castrating and dehorning of the host animal. These processes lead to myiasis in the host animal. Navels of newborns also can be a site of infestation.

-The *hominivorax* tends to reproduce only on the flesh of a living host. Unlike most other maggots, the *hominivorax* maggots will attack and consume healthy living tissue along with decaying tissue.

Life cycle:

-The general life cycle of *Cochliomyia* is similar to any other Diptera.

-There are four stages, egg, larvae, pupa, and adult. This entire life cycle lasts an average of 21 days at prime conditions (preferably a warm, moist



environment), and can last as long as two to three months in colder climates.

Treatment:

-Clean the wound and surroundings with warm water.

-Remove (using forceps) as many larva as possible.

-Collect and destroy removed larva using hot water or insecticide.

-Apply topical treatment to the wound to kill any remaining larva.

Prevention and control:

-Regularly inspect animals for wounds.

-Insect control as by sterile insect technique.

III-Mycotic Zoonoses (Mycoses)

-Most of fungi have natural habitat: soil, water, air, decaying organic matter and inanimate objects.

Fungi are classified into:

Yeast: Unicellular fungi reproduce by budding, 37⁰C ex. *Candida* colonies.

Mold: Multicellular, hyphae, 25⁰C, ex. *Aspergillus fumigates*.

Dimorphic fungi: thermally dimorphic.

-Both sexual and asexual spore may be produced.

Mycotic zoonoses can be classified into:-

A- Superficial mycoses.

B- Subcutaneous mycoses.

C- Systemic mycoses.

A-Superficial Mycoses (Cutaneous mycoses, Dermatomycoses, Dermatophytoses)

-The fungi of dermatomycosis are found in their parasitic form which growing only on keratinized layer of the epidermis or hair follicles, nail and keratinized portion of the hair.

-From the ecological point of view there are three genera of dermatophytes are distinguished according to their reservoir host and natural habitat:

1-Anthropophilic group:

Primary fungi of human which may be infect animals e.g. *Epidermophyton floccosum*.

2-Zoophilic group:

Primary fungi of animals and may infect human e.g. *Microsporum canis*, *Trichophyton mentagrophytes var mentagrophytes*, *Trichophyton verrucosum*

3-Geophilic group:

Fungi found commonly in soil of many localities and can infect both man and animals e.g. *Microsporum gypseum*.

- Superficial mycoses or dermatomycoses include:

1- Ringworm.

2- Favus.

1- Ringworm (Tinea)

-Tinea / Ringworm is the infection of keratinized structures, including the hair, nails, and stratum corneum of the skin, by *Microsporum*, *Trichophyton* and *Epidermophyton*.

-Ringworm is a common infection of cats, dogs, cattle and horses caused by the fungi *Trichophyton* spp. and *Microsporum* spp.

-The lesions are commonly circular in form, and historically were believed to be caused by a worm, hence its common name.

-The most commonly identified zoonotic organisms causing ringworm in humans are *Microsporum canis*, carried by dogs and cats.

-*Trichophyton verrucosum*: carried by cattle.

-Lesions in animals include alopecia, scaly patches, broken hairs, folliculitis and pustules.

Mode of transmission:

-N.B. Fungi thrive in moist, warm areas, such as locker rooms, beds, swimming pools and in skin folds. It can be spread by sharing sport goods, towels, and clothing.

-Fungal spores are shed by the animal host and then passed to humans either by:

1-Direct contact with an infected animal.

2-Indirect contact with animal housing, fences and other contaminated fomites.

-Spores can remain viable for long periods of time, especially in unclean conditions.

Clinical feature:

-Generally after an incubation period of approximately 10-12 days, characteristic lesions. The circular appearance is caused by the healing of the central area, while the organism proliferates outward.

-The fungus establishes in the hair follicles and may cause the hair shaft to fracture at skin level. This leads to hair loss, which may be permanent in some cases.

-Established infections gradually lose the circular appearance as they progress away from the initial site of infection.

-The lesions are red, scaly, itchy and inflamed, oozing and crusted, especially where secondary infection after scratching occurs.

-The lesion tends to be circular but vary in appearance according to the site.

1- *Tinea Capitis* (scalp ringworm).

2- *Tinea corporis* (body ringworm).

3- *Tinea barbae* (chin ringworm).

4- *Tinea cruris* (ring worm of the groin and preneal region).

5- *Tinea pedis* (Athlete's foot).

6- *Tinea unguium* (Onychomycosis) (ring worm of the nail).

2-Favus (*Tinea favosa*)

-It is cup shape yellow mass of fungus and tissue debris with a characteristic mousy odor. The lesion appears stuck on the scalp and usually ended with scarring and permanent focal alopecia.

Cause:

-*Trichophyton schoenleinii* in human.

-*Trichophyton gallinae* in poultry, causing white comb disease.

Source and reservoir:

-The main source of infection is human being and diseased animals.

-Reservoirs include poultry, cats, rats, mice, dogs, cattle and horse.

Mode of transmission:

-Direct contact between diseased and healthy individuals in family and in public establishments as well as by contact with contaminated articles.

-Contact with infected animals sick or apparently healthy carrier or indirectly by spores present in hair and dermal scales from such animals.

Clinical sings:

-Disease is characterized by a number of yellowish, circular, cup-shaped crusts (scutula) grouped in patches like a piece of honeycomb, each about

the size of a split pea, with a hair projecting in the center and mousy odor is often present. These increase in size and become crusted over.

-Hair become involved appear lusterless loss its elasticity and broken.

Diagnosis of superficial mycosis:

1-Examination of the patients:

-Clinical manifestations: The symptoms are patchy alopecia and scaling with varying degrees of inflammation.

2-Diagnosis in animals and humans may be assisted by the use of an ultraviolet light, because the lesions will often fluoresce.

Treatment:

-The condition is usually self-limiting, although use of topical and/or systemic antifungals may be required.

Prevention:

-Infected animals should be treated when clinical signs develop.

-Individuals identified as being particularly at risk should be encouraged to handle animals as little as possible, particularly where animals are wild or feral in habit.

-As the disease can arise from fomite transfer, animal pens, blankets, bedding should be disinfected and cleaned to prevent initial infection.

B-Subcutaneous mycoses

Sporotrichosis (Rose handler's disease)

Cause:

Sporothrix schenckii: Only one active species.

-Thermally dimorphic fungus which is distributed worldwide. More common in temperate or tropical zones.

-*Sporothrix schenckii* is dimorphic fungi found in mycelial form at 25° C and in the form of yeast with cigar shape yeast in vivo & at 37° C.

-It is isolated from soil, living and decomposing plants, woods.

Reservoir:

All infected animals as horse, mule, dog, cat, rat, mice & armadillo.

Source:

-Soil act as a source of infection.

-Living and decomposing plants, woods.

Mode of transmission:

-Wound infection by handling thorny plants. Generally infection occurs through skin prick, cuts, or small punctures.

-Inhalation of air or dust containing spores of *S. schenckii*.

-Laboratory infection by culture of the microorganism.

-It is an occupational disease of farmers, horticulturists, gardeners,

Clinical signs:

Incubation period: 3weeks-3months.

1-Cutaneous or skin sporotrichosis:

- This is the most common form of this disease.
- Usually cutaneous sporotrichosis lesions occur in the finger, hand, and arm.
- Symptoms of this form include nodular lesions in the skin, at the point of entry and also along lymph nodes and vessels.

2-Pulmonary sporotrichosis:

- This rare form of the disease occurs when *S. schenckii* spores are inhaled. Symptoms of pulmonary sporotrichosis include productive coughing, nodules and cavitations of the lungs, fibrosis, and swollen hilar lymph nodes.

3-Disseminated sporotrichosis:

- Disseminated type is rare and mostly occurs in Immunocompromized patients.
- The infection can spread to joints and bones (called osteoarticular sporotrichosis) as well as the central nervous system and the brain (called sporotrichosis meningitis).

Diagnosis:

- Clinical manifestation.**
- Microscopical examination:**
- Routine culture media**

Prevention:

- Rodent control.

-The majority of sporotrichosis cases occurs when the fungus is introduced through a cut or puncture in the skin while handling vegetation containing the fungal spores. Prevention of this disease includes wearing long sleeves and gloves while working with suspected sources.

-Proper handling of laboratory equipments.

Treatment:

-Treatment of sporotrichosis depends on the severity and location of the disease.

-Surgery: In cases of bone infection and cavitary nodules in the lungs, surgery may be necessary.

C-Systemic mycoses

Systemic mycoses infect deep tissues; lung, bone, CNS.....etc.

-They may be caused by:

1-Primary pathogens: as *Histoplasma capsulatum*, *Coccidioides immitis* and *Blastomyces dermatitides*. All these strains are considered as diphasic or dimorphic fungi.

-They are soil saprophyte and live in restricted ecological area with the soil become contaminated by the excreta of birds or animals. Through inhalation the respiratory system becomes infected.

2-Opportunistic pathogens: such as *Asprigillus fumigates*, *Candida albicans* and *Cryptococcus neoformans*.

-They cause disease only when the body resistance is lowered and cause invasive disease in the immunocompromized individuals.

1-Aspergillosis
(Pneumomycosis, bronchomycosis)

Causative agents:

Certain species of *Aspergillus*. The most frequently identified pathogen is *Aspergillus fumigatus*.

Source and Reservoir:

-Soil, cattle, birds, horse, dog and man act as reservoir of infection.

-*Asprigillus* are ubiquitous in nature; many species are pathogenic for plants, birds and domestic animals causing brooder pneumonia in birds and bovine mycotic abortion in cattle.

-Immediate source of the spores are soil, water, food stuff, mouldy grains, hay, bedding and clinical materials.

Mode of transmission:

-Transmission mainly by inhalation of spores from moldy grains.

-It is a serious opportunistic threat to AIDS, leukemia, and transplant patients.

-It is an occupational disease to squab feeders.

Clinical signs:

-Acute pulmonary form: It may cause repeated coughing up of blood, chest pain, and occasionally severe, even fatal, bleeding.

-Chronic pulmonary form: It can grow in an old tuberculosis lesion forming dense fungal mass known as (aspergilloma , fungal ball). A fungus ball in the lungs may cause no symptoms and may be discovered only with a chest X-ray.

-Progressive form: poorly controlled aspergillosis can disseminate through the blood stream to cause widespread organ damage. Symptoms include fever, chills, shock, delirium, seizures and blood clots. The person may develop kidney failure, liver failure and breathing difficulties. Death can occur quickly.

N.B. Aspergilloma: is a fungus ball that colonizes in a healed lung scar or abscess from a previous disease.

Diagnosis:

-Chest X-ray and CT.

-Cultivation and microscopic examination: cultivation of suspected material on SDA media and microscopic examination of the arial growth using lactophenol cotton blue and examined microscopically.

Treatment:

-Amphotericin B.

Prevention:

-Prevention of aspergillosis involves a reduction of mold exposure via environmental infection-control.

-Anti-fungal prophylaxis can be given to high-risk individuals.

2-Histoplasmosis

Darling's disease, "Ohio valley disease," "Reticuloendotheliosis

Causative agent:

Histoplasma capsulatum.

Histoplasma capsulatum is found in soil, often associated with decaying bat or bird droppings.

Source:

-Contaminated soil in endemic areas where infection exists in man and animals.

-Discharge from skin lesions and sputum of infected animals.

-Bird and bat droppings in soil promote growth of *Histoplasma*.

Reservoir:

Natural reservoir: soil, bat and avian habitats, old chicken coops, etc...

Mode of transmission:

-Inhalation of dust particles containing spores.

Clinical forms:

1) Acute Pulmonary histoplasmosis.

2) Chronic cavitory histoplasmosis.

3) Disseminated histoplasmosis.

-Symptoms start within 3 to 17 days after exposure (the average is 12–14 days).

-Most affected individuals show no apparent illness.

-The acute phase of histoplasmosis is characterized by non-specific respiratory symptoms, often cough or flu-like. Chest X-ray findings are normal in 40–70% of cases.

-Chronic histoplasmosis cases can resemble tuberculosis.

-Disseminated histoplasmosis: severe infections can cause hepatosplenomegaly, lymphadenopathy. Lesions have a tendency to calcify as they heal. Disseminated histoplasmosis affects multiple organ systems and is fatal unless treated.

Diagnosis:

-Samples containing the fungus taken from sputum, blood, or infected organs can be examined by:

1. Microscopic examination: smears from sputum or other lesions stained with Giemsa / Wright stain and examined by oil immersion lence. The fungus appears as a small Intra- and extracellular yeast cells with oval bodies.

2. Culture: on BHI or SDA reveal dimorphic fungi.
3. Serology: as complement fixation test
4. Skin test: By using culture filtrate which injected intradermally. *Histoplasma* skin tests indicate whether a person has been exposed, but do not indicate whether they have the disease.

Treatment:

- In the majority of immunocompetent individuals, histoplasmosis resolves without any treatment.
- Antifungal medications are used to treat severe cases of acute histoplasmosis and all cases of chronic and disseminated disease.
- Typical treatment of severe disease involves treatment with amphotericin B, followed by oral Ketoconazole.

Prevention:

- Reduce a person's risk of exposure, in the area where the disease is prevalent.
- Avoid accumulations of bird or bat droppings.
- Personal protective equipment that may reduce the risk of infection when exposed to chicken runs, bats and in soil.

3-Coccidioidomycosis (valley fever, Desert rheumatism)

Causative agent:

Coccidioides immitis is a dimorphic saprophytic organism that grows as a mycelium in the soil and produces a spherule (spherical bodies) form in the host organism.

Source and reservoir of infection:

-It resides in the soil in certain parts of the southwestern United States.

Mode of transmission:

-Infections usually occur due to inhalation of the spores after soil disruption.

-Laboratory infection by inhalation of spores from the culture of the fungus.

-Infection through the open wound is possible.

Clinical signs:

Incubation period is from 1-4 weeks.

-Most infected people have no or minimal symptoms.

-Of those who develop symptoms, there are two clinical forms:

1-Acute pulmonary form:

-Symptoms resembling bronchitis or pneumonia that resolves over a few weeks. Notable coccidioidomycosis signs and symptoms include a profound feeling of tiredness, fever, cough, headaches, rash, muscle pain, and joint pain.

2-Progressive coccidioidomycosis:

Serious complications may occur in patients with weakened immune systems, including severe pneumonia, lung nodules, and possible disseminated form, causing skin ulcers, abscesses, bone lesions, swollen joints with severe pain, urinary tract problems, and inflammation of the brain's lining (a common cause of “fungal meningitis) which can lead to death.

Diagnosis:

-Diagnosis relies on a combination of an infected person's signs and symptoms .Findings on radiographic imaging, and laboratory results.

Treatment:

Mild asymptomatic cases often do not require any treatment.anti-fungal therapy as oral fluconazole and intravenous amphotericin B are used in progressive or disseminated disease, or in immunocompromised individuals.

Prevention:

-Recommended preventive measures include avoiding airborne dust.

-Dust control measures such as planting grass and wetting the soil, and also limiting exposure to dust storms are advisable for residential areas in endemic regions.

4-Candidiasis (Moniliasis)

Causative agent:

-The genus *Candida*.

-*C.albicans* is the most significant pathogenic species.

-*Candida* is round, oval, cylindrical or elongated body of 3-5 micron in diameter; reproduce by budding.

Reservoir:

All avian & mammalian spp., birds, cattle, swine and man.

Source:

1-Endogenous source:

-*Candida* yeasts are generally present in healthy humans, particularly on the skin, but their growth is normally limited by the human immune system, by competition of other microorganisms, such as bacteria occupying the same locations in the human body, and in the case of skin, or by the relative dryness of the skin, as *Candida* requires moisture for growth.

-*Candida* species are frequently part of the human body's normal oral and intestinal flora.

2-Exogenous source:

-Secretion of infected man and animals.

-Milk from infected cattle.

-Sputum from infected persons.

Mode of transmission:

-Infection is usually endogenous, but occasionally exogenous.

-*C.albicans* is found in the bedding of infected individuals so it can be transmitted by direct contact.

-Infection can be transmitted by contact with secretions of mouth, skin, vagina, feces of infected or carrier individuals. Mother with vaginal candidiasis can infect their babies during delivery.

-Infants may be infected from their mothers during breast feeding but the artificially fed babies more affected than the naturally fed ones.

-Predisposing factors includes:

-Infections of the mouth are most common among children less than one month old, the elderly, and those with weak immune systems as HIV/AIDS patients, after organ transplantation, diabetes, and the use corticosteroids and antibiotic therapy.

Disease in humans:

1-Candidiasis of skin, mucous membranes and nails

a) Oral thrush (thrush, oropharyngeal candidiasis): It is commonly occurs in infants and characterized by creamy white patches on a red inflamed mucous membrane of the mouth, tongue and throat.

-The lesion may be seen as single large or multiple small patches scattered over the mucous membrane which loosely attached to the mucosa and its removal leave a bright red moist base.

b) Vaginal thrush (Candidal vulvovaginitis, vaginal yeast infection):

Symptoms include genital itching, burning, and sometimes a white discharge from the vagina.

-It commonly occurs during pregnancy and in diabetes persons.

c) *Candida* onychomycosis (infection of the nail): Which lead to candidal paronychia where the nail become red, painful, tenderness and swelling which often resemble pyogenic lesions but don't contain pus. The nail thickening, hard, show transverse grooving with accumulation of depresses which may take the brown color.

d) Candidiasis of the skin and of large body folds: Superficial infection of the skin which results from prolonged exposure to moisture. The lesions frequently seen in diabetics and in individuals subjected to frequent emersion in water as in fish handlers, cooks and housewives.

-Erythema, exudation and desquamation of the epithelial cells. The lesion localized in large damped folds as axilla, groin, inframammary areas and inter-digital clefts.

2-Systemic Candidiasis (Invasive candidiasis):

a) Pulmonary candidiasis: *Candida* infection may be a secondary invader of the lung where a pre-existing disease, characterized by cough, expectoration, and patients expel mucoid, gelatinous sputum sometimes streaked with blood.

b) Disseminated candidiasis: (multiple system involvement, e.g. "hepatosplenic candidiasis" Ultrasound of liver shows area of necrosis containing fungi surrounded by a zone of inflammatory cells.

Diagnosis:

-Diagnosis of a yeast infection is done either via microscopic examination or culturing.

-Microscopic examination: identification by light microscopy, a scraping or swab of the affected area is placed on a glass slide. A single drop of 10% KOH solution is then added to the specimen. The KOH dissolves the skin cells, but leaves the *Candida* cells intact, permitting visualization of pseudohyphae budding yeast cells typical of many *Candida* species.

-Culturing method: a sterile swab is rubbed on the infected skin surface. The swab is then streaked on a culture medium SDA. The culture is incubated at 37°C and 25°C for several days 2-4 days, to allow development of yeast or bacterial colonies. The characteristics colonies (creamy medium with moist to dull appearing colonies) allow initial diagnosis of the organism causing disease symptoms.

Treatment:

Candidiasis is commonly treated with antifungal drugs include topical nystatin.

Prevention and control:

-General hygienic measures are useful in preventing the disease.

-Neonatal thrush can be prevented by treatment of vaginal candidiasis in pregnant women.

-Prevention of the disease in chickens by disinfection with an iodine solution before incubation.

5- Blastomycosis (North American blastomycosis, Blastomycotic dermatitis)

-It is a chronic mycotic infection characterized by the formation of suppurative and granulomatous lesion in any part of the body mainly skin, lung and bones.

Causative agent:

Blastomyces dermatitidis.

-In endemic areas, the fungus lives in soil and rotten wood near lakes and rivers.

Source:

-Contaminated soil.

-Discharge of skin lesions and sputum of infected animals.

Reservoir:

Soil, dog, horse, wolves, sea lion and man.

Mode of transmission:

-Contact with contaminated soil.

-Inhalation of dust containing infectious agent (air-borne infection).

-Inoculation through wound caused by trauma with introduction of the organism.

Disease in animals:

Animals especially dogs suffered from fatal pulmonary infection in the form of granulomatous and suppurative pneumonia.

Disease in humans:

Blastomycosis can present in one of the following ways:

1-Pulmonary blastomycosis:

-A flu-like illness with fever, chills, arthralgia, myalgia, headache, and a nonproductive cough which resolves within days.

-An acute illness resembling bacterial pneumonia, with symptoms of high fever, chills, a productive cough, and pleuritic chest pain.

-A chronic illness that resemble to tuberculosis or lung cancer, with symptoms of low-grade fever, a productive cough, night sweats, and weight loss.

2-Cutaneous blastomycosis:

-Skin lesions, usually asymptomatic, can be wart-like due to chronic inflammatory hyperplasia of the skin.

3-Generalized blastomycosis:

It occurs secondary to pulmonary form and characterized by involvement of subcut tissue, brain or other body parts. 40% immunocompromised individuals have CNS involvement and present as brain abscess, or meningitis.

Diagnosis:

-Blastomycosis can usually be confirmed by demonstration of the characteristic broad based budding organisms in sputum or tissues by KOH prep, the organism appear as single or budding spherical cells 8-15u in diameter with a thick refractile wall.

Treatment:

-Potassium iodide

-Itraconazole given orally is the treatment of choice for most forms of the disease.

Prevention and control:

-Suppression of dust.

-Condemnation of infected animals.

6- Cryptococcosis (human torulosis)

Cryptococcosis is chronic and a potentially fatal fungal disease.

-Distribution is worldwide in soil.

Causative agent:

Cryptococcus neoformans:

Mode of transmission:

Cryptococcosis is believed to be acquired by inhalation of the infectious spore from the environment especially soil contaminated by pigeons excreta.

Disease in humans: In humans, *C. neoformans* causes three types of infections.

1-Wound or cutaneous cryptococcosis: The lesions are small granulomas, which develop so rapidly as similar abscesses. Enlargement of the lymph nodes may occur. The cryptococcal meningitis follows the cutaneous form sooner or later.

2-Pulmonary cryptococcosis: It is a primary infection of the lung which is similar to T.B and terminates as Cryptococcal meningitis.

3-Cryptococcal meningitis: Cryptococcal meningitis (infection of the meninges, the tissue covering the brain) is believed to result from dissemination of the fungus.

Diagnosis:

-Dependent on the infectious syndrome, symptoms.

-Microscopic examination: direct microscopic examination of specimens mounted in Gimsa stain or Indian ink diluted 50% that showing round cells surrounded by refractile capsule.

-Cultivation of suspected materials on SDA media which reveal creamy yeast colonies.

Prevention:

-Suppression of dust.

-Hygienic disposal of pigeon's excreta.