

4. Blood loss (The quality and quantity)

- **Ancylostoma caninum (hookworm)**... suck blood
 - Each worm suck 30-200 μ l blood daily Decrease in hemoglobin level (12-15 %)
 - Decrease in erythrocyte count from 6.800.000 to 800.000.
 - Severe infections lead to **iron-deficiency anaemia** and develop a **microcytic hypochromic anaemia**.
 - Protein and iron intake is insufficient.
 - Anticoagulants increase blood loss in gut and prevent blood' coagulation

Clinical signs: anemia, diarrhoea (contain blood and mucus), weight lose, loss of appetite

- **Ectoparasites** ... suck different amount of blood and they easily suck blood with anticoagulants without blood clotting, easily.
e.g. mosquito, louse, flea, bed bugs, tick

Parasites like hookworm, leech / flea, tick release **anticoagulants** and **prevent blood coagulation**. Anticoagulants increase blood loss and prevent coagulation

- **Diphyllobothrium latum**....steal host nutrients and absorb Vit B12
 - Pernicious anaemia (macrocytic).
 - Reduced RBC counts and hemoglobin level
 - Increased **eosinophil leukocyte counts**★
 - They lead to **fatigue, diarrhoea, vomiting, neurological symptoms (dizziness, numbness of extremities)**
- **Eosinophil leukocytes** increase in both **parasitic infections** and **allergic reaction**. Parasites are the most common cause. Eosinophil leukocytes cause phagocytose and, damage to larval stages of parasite

- **Blood forming organs (bone marrow) are affected**changes in red blood cells
 - If RBC are normal sized.....Normocytic anemia
 - If “ are large.....Macrocytic anemia
 - If “ are small.....Microcytic anemia
 - If “ have iron deficiency.....Hypochromic anemia (pale, relatively colorless)
 - If “ have different in shapes.....Poikilocytosis (severe anemia sign)
 - If “ have different in sizes..... Anisocytosis

5. Carry parasitic diseases from one host to another (Transmission of parasites).

Some parasites or intermediate hosts cause to pass on infection from one animal/person to another. When blood-sucking insects containing parasites bite the host skin, they inject the parasites into the host blood-stream.

- **Mosquito (Anopheles)** is intermediate host and also known as a vector of human malaria (**P. falciparum**) and the human lymphatic filarial nematodes (**W. bancrofti**). The mosquitoes transmit these diseases.

Clinical signs in malaria: severe blood loss, shivering, fever, dizziness, headache, bone pains and clogged blood vessels.

Clinical signs in elephantiasis: swelling in extremities, thickening of tissue, hardening

- **Mosquito** (Clucidae)...it is vector of the dog heartworm (**Dirofilaria immitis**).
Clinical signs: cough, weakness, exercise intolerance, hypertension, abdominal ascites, pulmonary edema, lethargy, heart failure
- **Tick**.....it is responsible for the transmission of **babesiosis**, **piroplasmosis** and **theileriosis** in animals

Clinical signs: **Theileria** diseases cause high fever, swelling of the lymph nodes, dyspnea, lacrymation, nasal discharge and high mortality in cattle

Clinical signs of **Piroplasma**: acute fever, lack of appetite, discomfort, anemia, icterus, weight lose, poor exercise tolerance and sudden death

- **Phlebotomus**=sandfly=tatarcık...it known vectors of **leishmaniasis** in humans.

Clinical signs:

Visceral leishmaniasis.....irregular fever, weight loss, anemia, hepatomegaly, splenomegaly

Cutaneous leishmaniasis.....ulcers and then lifelong scar

(It usually produces ulcers on the exposed parts of the body, such as the face, arms and legs)

- **Biting flies=tsetse fly**=Çeçe sineği...it is important in the transmission of sleeping sickness in humans (**Trypanosomiasis**).
- It affects neuron, muscle, macrophage and epithelial cells.

Clinical signs: fever, headache, itching, lethargy, sleeping sickness=changes of behaviour disturbance of the sleep cycle (neurological / meningoencephalic stage)
swelling lymph nodes

- **F. hepatica, D. dendriticum, C. tenuicollis**.....**C. novyi** may cause clostridial necrotic hepatitis “**black diseases**”.
- Normally clostridium (bacteria) is found in liver and gut of healthy animals and their endospore are dormant. But, these parasites migrate the liver (usually caused by migration liver fluke), bacterial spores begin to grow, germinate (multiply) and produce toxin and cause liver damage and necrosis).

Clinical signs: fever, abdominal pain, icterus, dyspnea, hemoglobinuria, dark color feces and finally death

- **Heterakis gallinarum**.....**Histomonas meleagridis** (protozoon)=blackhead diseases is transmitted by another caecal parasites called as *H. gallinarum*. Transmission happens with *Heterakis gallinarum* eggs.
 - *Histomonas* goes into the *Heterakis* eggs
 - Eggs pass in the feces
 - Infected eggs and/or earthworms containing juvenile *Heterakis* worms are ingested by eating or drinking (contaminated water, feed, bedding, or soil)
 - *Histomonas* protozoan invades caecum and cause enterohepatit.

Clinical signs: loss of appetite, poor growth, increased thirst, sulphur-yellow diarrhoea, drooping wings, unkempt feathers, black head and death in turkeys (less damage in chickens).

6. Effects of toxins. Many parasites can introduce secret toxin and cause damage to host. The host often produce immunopathologic responses.

- Allergic reactions occur with **insect** bites (**flea, tick, mosquitoes, scorpion** and **spiders** introduce venom when they insert their mouth parts into the skin). Toxin excretory products of the parasite are often allergenic and cause itching and burning sensations.

Clinical signs: The reaction of the skin varies from unimportant to lethal but usually includes inflammation, edema, pruritis (intermittent scratching), wheal on the skin, alopecia, dermatitis, eczema.

- In **Hymenolepis nana, Enterobius vermicularis** and **Ascaris lumbricoides**, toxins cause nervous manifestations appear (**dizziness, insomnia, nail biting, grinding teeth, scratching nose, drooling**)

7. Lysis effect (with enzymes) Capable of doing lysis and produce ulser. To facilitate skin and intestinal mucosa tissue invasion, parasites release enzymes like collagenase, proteolytic, hemolysin etc.

Hookworm.....collagenase.....for skin penetration and migration of parasites

Tick.....proteolytic and hemolysin..... for skin penetration via enzymes and hipostom

Hypoderma migration is aided by mouth hooks and secretion of proteolytic enzymes

8. Stimulation of host tissue reactions=Pathological changes. Parasitic infections may contribute to tissue disorder.

❖ **Neoplasia...** a new and abnormal growth of cells and may develop into a tumour.

Schistosoma hematobium can cause cancer in human bladder..... **Blood/blood clots in urine, pain/burning sensation during urination, frequent urination, feeling the need to urinate many times throughout the night, feeling the need to urinate**

Spirocerca lupi can cause oesophageal granulomas, up to 4 cm in size. Other complication is the development of osteosarcoma....**Dysphagia and vomiting arising from obstruction**

- ❖ **Hyperplasia**=cellular proliferation=an abnormal increase in the number of cells a body tissue or organ. Increase in the reproduction rate of organ or tissue' cells.
Fasciola hepatica can cause sclerosis of bile ducts in cattle
- ❖ **Metaplasia**. Abnormal change in the nature of a tissue.
Paragonimus westermanii..cylindrical epithelium changes squamous epithelium.
- ❖ **Inflammation**. This is localize physical condition. The part of the body against the infection become **redness, swelling, hot, painful**.
Trichinella spiralis adults occur in glandular crypts of small intestine

9. Immuno-pathological reactions. Parasitic antigens stimulate both a cellular and humoral immune response provoking tissue reactions consisting a cellular proliferation and infiltration at the site of parasite antigens, or deposition of circulating immune complex.

Parasite antigen → Immune system
e.g Anaphylaxis

Immune response

Allergy/
Hypersensitivity

Hypersensitivity: The metabolites, secretion, excretion or other products of parasites or dead worms may act as foreign antigen, to stimulate the immune system of host to produce immune response or hypersensitivity. **Hypersensitivity, is harmful to host**, which may lead to severe or even fatal reaction. **This is an abnormal or excessively sensitive reaction** (e.g. pollen, antibiotics, food, dust).

Anaphylaxis: acute, severe systemic allergic reaction to an antigen to which the body has become sensitive. **Sudden rupture of hydatid cysts** which release of large amount of fluid could result in severe allergic reaction..... sometimes lead to shock or death of patients.

Bee sting in sensitivity host.....cause anaphylaxis