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Anatomical Location of Parasites in Animals

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Abstract:

Parasites are organisms that live on or within a host and obtain nourishment at the host's expense. In animals, they occur in diverse forms, including helminths (worms), arthropods (such as lice, ticks, fleas, and mites), and protozoa. These parasites are broadly classified as ectoparasites, which inhabit the external surface of the body, and endoparasites, which live within internal organs and tissues. Different parasites show a strong preference for specific anatomical sites, including the gastrointestinal tract, liver, respiratory system, blood, muscles, nervous system, and reproductive organs. This tissue specificity directly influences the clinical signs, disease severity, diagnosis, and treatment outcomes. Understanding the anatomical localization of parasites in animals is therefore essential for effective disease management, control strategies, and improved animal health and productivity.

Keywords: Anatomical, Animals, Bronchi, Parasite, Small intestine

Introduction:

A parasite is an organism that lives on or within another organism (the host) and derives nourishment from it at the host's expense (Unit 4). Parasites affecting animals occur in diverse forms, including helminths (parasitic worms), arthropods such as lice, ticks, and mosquitoes, and protozoa. Globally, more than 1,000 species of parasites are known to infect domesticated animals. Based on their location within the host, they are broadly classified as external (ectoparasites) or internal (endoparasites) (Robin, 2024).

1. Ectoparasites:

Ectoparasites are organisms that inhabit the external surface of the host and may occasionally

penetrate the superficial layers of the skin. Their association with the host may be temporary, as seen in flies that feed briefly on body secretions, or more permanent, as in mites that reside within the skin. Examples of ectoparasites include fleas, lice, ticks, and mites (Robin, 2024).

1. **Ticks (*Ixodes* spp.):** These ectoparasites attach to animals such as dogs and cattle and feed on their blood.
2. **Fleas (*Ctenocephalides* spp.):** These parasites are commonly found infesting cats and dogs.
3. **Lice (Order Phthiraptera):** They inhabit the skin and hair of mammals, where they spend their entire life cycle.
4. **Mites (*Sarcoptes* spp.):** These burrowing parasites invade the skin and are responsible for causing mange.

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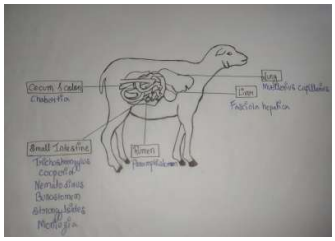

Fig 1: Sheep and Goat

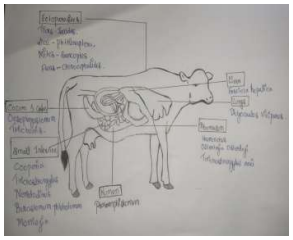

Fig 2: Cattle

2. Endoparasites:

Protozoa and helminths are endoparasites, which means they live inside the body of the host. They can infect the intestines, blood, and internal organs such as the brain, liver, eyes, and kidneys. Most endoparasites are either protozoa or worms. Helminths (worms) are divided into two main groups: flatworms and roundworms.

1. **Tapeworms (*Taenia* spp.):** These intestinal parasites inhabit the digestive tract of domestic animals.
2. **Roundworms (*Ascaris* spp.):** They are common gastrointestinal parasites found in various animal species.
3. **Hookworms (*Ancylostoma* spp.):** These parasites reside in the intestines and can lead to anemia due to blood loss.
4. **Liver flukes (*Fasciola* spp.):** They infect the liver and bile ducts of their hosts.
5. **Heartworms (*Dirofilaria immitis*):** These parasites live in the heart and major blood vessels.
6. **Malarial parasites (*Plasmodium* spp.):** They invade and multiply within red blood cells.

3. Gastrointestinal Tract Parasites:

i. Common locations of parasitic infestation in cattle.

a) *Paramphistomum* spp (Flukes).

Anatomical location: The adult parasites are mainly found in the rumen and reticulum, where they attach to the ruminal papillae. The immature stages are located in the duodenum and abomasum, where they

produce the most severe and pathogenic lesions.

b) *Haemonchus* spp, *Ostertagia ostertagi*, *Trichostrongylus axei* and *Mecistocirrus digitatus*.

Anatomical location: The adult worms inhabit the abomasum, where they attach to the mucosal lining and feed on blood. *Trichostrongylus axei* is specifically located within the abomasal mucosa and gastric glands.

c) *Cooperia* spp, *Trichostrongylus* spp, *Strongyloides papillosus*, *Bunostomum phlebotomum* (Hookworm), *Nematodirus* spp, *Toxocara vitulorum*, *Moniezia* spp, *Aonchotheca bovis*.

Anatomical location*: Cooperia* spp. are located in the small intestine, particularly in the anterior (proximal) region. *Trichostrongylus* spp. inhabit both the abomasum (fourth stomach) and the small intestine. *Strongyloides papillosus* occurs in the small intestine of cattle, where it is embedded in the mucosa of the duodenum and upper jejunum. In *Bunostomum phlebotomum*, adult worms are typically found in the duodenum and proximal jejunum, where they attach to the mucosa and feed on blood. *Nematodirus* spp., *Toxocara vitulorum*, *Moniezia* spp., and *Aonchotheca bovis* (formerly *Capillaria* spp.) are also primarily located in the small intestine of cattle.

d) *Oesophagostomum* spp, *Chabertia ovina* (sheep) and *Trichuris* spp.

Anatomical location:

Oesophagostomum spp: The adult worms live in the large intestine, mainly in the caecum.

Chabertia ovina: The adult parasites are found in the colon.

Trichuris spp: Adult whipworms are present in the caecum and colon, with their front ends embedded in the intestinal lining.

ii) Common location of parasitic infestation in small ruminants:

a) Common parasites of the abomasum: *Teladorsagia circumcincta*, *Ostertagia trifurcata*, *Trichostrongylus axei*, and *Mecistocirrus digitatus*.

Anatomical location: These parasites are mainly found in the abomasum, particularly in the abomasal lumen and gastric glands.

b) Common parasites of the small intestine: *Gaigeria* spp. (hookworms) and *Thysanosoma actinioides* (fringed tapeworm) (VanHoy, 2024).

Anatomical location*: Gaigeria* spp. are present in the small intestine, especially in the duodenum and jejunum of ruminants, where they feed on blood. *Thysanosoma actinioides* is mainly located in the bile ducts, pancreatic ducts, and sometimes the small intestine of cattle.

4. Liver Parasites:

Many parasites move through different tissues during their life cycle, which may help them survive and reproduce more successfully. *Fasciola hepatica* (common liver fluke) lives as an adult in the bile ducts of the liver of its definitive hosts, mainly sheep, cattle, and goats. Parasites such as Ascaris, Schistosoma,

and Plasmodium also involve the liver in their life cycle. The liver has a unique immune environment that tends to promote tolerance rather than a strong immune response. Some parasites may take advantage of this feature to escape the host's immune defenses. For example, *Plasmodium* spp. uses the liver as a site for multiplication. However, many larvae are destroyed in the liver during infections such as ascariasis and schistosomiasis (Deslyper *et al*., 2019).

Anatomical location: The adult stage of *Fasciola hepatica* is mainly found in the bile ducts and sometimes in the gallbladder. Ascaris is commonly located in the small intestine of pigs. Schistosoma (blood flukes) are usually present in the blood vessels of birds and mammals, particularly in the mesenteric veins or the veins of the urinary bladder. Plasmodium parasites occupy different sites in the vertebrate host depending on their stage of development, including the liver, bloodstream, bone marrow, and lung capillaries.

5. Respiratory System Parasites:

i) Common location of parasitic infestation:

a) *Dictyocaulus viviparus* in cattle.

Anatomical location: It is mainly found in the respiratory system, particularly within the lumen of the trachea, bronchi, and bronchioles.

b) Dirofilaria in goats and sheep.

Anatomical location: Bronchioles and bronchi.

c) *Dirofilaria eckerti* and *Dirofilaria cervi* in deer

Anatomical location: Adult worms were primarily located in the bronchi and bronchioles of the lungs, especially in the caudal lobes.

d) *Dirofilaria arnfieldi* in donkeys and horses

Anatomical location: In donkeys (the natural host), mature worms are located in the bronchi, where they lay eggs. In horses, the parasites are primarily found in the bronchioles.

e) *Protostrongylus rufescens* and *Muellerius capillaris* in sheep and goats

Anatomical location: Adult *Protostrongylus rufescens* are located in the smaller bronchioles, whereas *Muellerius capillaris* (hair lungworm) is found in the subpleural spaces and alveoli.

f) *Metastrongylus apri*, *Metastrongylus pudendotectus*, and *Metastrongylus salmi* in pigs

Anatomical location: These parasites are located in the bronchi and bronchioles of the lungs, with a marked predilection for the posterior (diaphragmatic) lobes.

g) *Oslerus osleri*, *Crenosoma vulpis*, and *Eucoleus aerophilus* in dogs

Anatomical location: Adult *Oslerus osleri* reside in small, elevated fibrous nodules within the submucosa of the trachea and bronchi, especially near the tracheal bifurcation (carina). Adult *Crenosoma vulpis* (fox lungworm) are located in the bronchi and bronchioles. Adult *Eucoleus aerophilus* (formerly *Capillaria aerophila*) are embedded within the epithelium or mucosa of the trachea, bronchi, and bronchioles.

h) *Aelurostrongylus abstrusus* and ***Eucoleus aerophilus*** in cats (Ballweber, 2024):

Anatomical location: Adult *Aelurostrongylus abstrusus* (feline lungworm) live deep in the lungs, mainly in the alveoli, alveolar ducts, and terminal bronchioles. *Eucoleus aerophilus* (*Capillaria aerophila*) are found in the lining beneath the mucosa of the trachea, bronchi, and bronchioles.

6. Blood Parasites:

a) *Mycoplasma haemocanis* is a parasitic organism that attaches to and lives on the red blood cells of infected dogs (Tabor *et al*., 2024).

Anatomical location: On the surface of erythrocytes (red blood cells) circulating in the bloodstream.

b) Hepatozoonosis is a disease affecting both wild and domestic carnivores, caused by protozoan parasites of the genus Hepatozoon.

Anatomical location of Hepatozoon Stages:

In domestic dogs (*Hepatozoon canis*), gamonts are located within the cytoplasm of neutrophils. In domestic and wild cats (*Hepatozoon felis*), gamonts are usually rare in blood smears but may be observed in leukocytes. In wild canids and felids, including species such as red foxes, ocelots, and pumas, gamonts are present within leukocytes, particularly monocytes and neutrophils.

c) In sub-Saharan Africa, they serve as vectors for a group of protozoan diseases caused by members of the genus Trypanosoma, which affect all domestic animals.

Anatomical location:

→ **Subcutaneous tissue** (inoculation site): Infection begins when an infected tsetse fly injects the parasites into the skin, often resulting in the formation of a trypanosomal chancre at the site of the bite.

→ **Lymphatic system and bloodstream** (first stage): The parasites spread from the skin into the lymphatic system and bloodstream, producing clinical signs such as fever, joint pain, and enlargement of the posterior cervical lymph nodes (Winterbottom's sign).

→ **Central nervous system** (second stage): In advanced stages, the parasites cross the blood–brain barrier and invade the brain, spinal cord, and cerebrospinal fluid (CSF), leading to neurological manifestations.

→ **Adipose tissue** (reservoir): Recent evidence suggests that adipose (fat) tissue serves as an important additional reservoir for the parasites.

7. Muscle Parasites:

a) In dogs and cats, common parasites that can cause lameness include lice, fleas, ticks (such as Amblyomma, Rhipicephalus, Haemaphysalis, and Dermacentor), and mange mites (*Sarcoptes scabiei*) (Akin *et al.,* 2025).

Anatomical location: Phthiraptera (lice) - in dogs and cats, are present directly on the skin and within

the hair coat. Siphonaptera, particularly *Ctenocephalides felis* (cat flea), are commonly found at the base of the tail, neck, around the ears, abdomen, groin, inner thighs, and along the back, especially near the tail.

Ticks (Order Ixodida) - generally located on the head, neck, and ears. Species-specific predilection sites include:

Amblyomma - commonly attached to the underbelly, inguinal (groin) region, axillae, and around the tail or perianal area.

Rhipicephalus - frequently found on the ears, head, neck, and between the toes (interdigital spaces).

Haemaphysalis - typically located on the ears, head, and neck.

Dermacentor - often attached around the ears, head, neck, shoulders, and back; also found between the toes, on the underside of the tail (especially near its base), and in the inguinal region.

b) In pigs, skin-embedded female sand fleas (*Tunga penetrans* and *Tunga trimamillata*) cause a zoonotic condition known as tungiasis.

Anatomical location: Coronary band, digits and claws.

8. Nervous System Parasites:

a) Pigs: *Taenia solium* (Carpio *et al.*, 2016).

Anatomical location: In the larval stage, the parasite is mainly found in the skeletal and cardiac muscles.

b) Cats (definitive hosts) and birds/rodents (intermediate hosts): *Toxoplasma gondii*

Anatomical location: In cats, the parasite primarily infects the epithelial cells of the small intestine. In birds and rodents, it commonly establishes chronic infection in neural and muscular tissues.

c) Sheep, goats, cattle, pigs, yaks, and other farm animals: *Echinococcus granulosus* and *Echinococcus multilocularis*.

Anatomical location: The liver is the primary and most frequently affected organ, followed by the lungs. Cysts may also occur in the spleen, kidneys, heart, brain, and bones.

d) Freshwater snails (intermediate hosts): *Schistosoma japonicum*, *Schistosoma mansoni*, and *Schistosoma haematobium*.

Anatomical location: In snails, these parasites are located in the digestive gland (hepatopancreas) and gonads.

e) Freshwater snails and crustacean-eating mammals: *Paragonimus westermani*

Anatomical location: In mammals, the parasite is primarily found in the lungs.

f) Vector-borne (Anopheles mosquito): *Plasmodium falciparum*

Anatomical location: The parasite infects the liver initially and later the bloodstream, including the venous microvasculature and bone marrow.

g) Cats: *Toxocara canis* and *Toxocara cati*

Anatomical location: Adult worms are mainly located in the small intestine.

h) Tsetse fly; wild ungulates and domestic cattle/pigs: *Trypanosoma brucei gambiense* and *Trypanosoma brucei rhodesiense*.

Anatomical location: *Trypanosoma brucei rhodesiense* is primarily found in the blood, lymph, lymph nodes, spleen, and cerebrospinal fluid (CSF).

9. Reproductive System Parasites: (Kaltungo and Musa, 2013)

a) *Neospora caninum* infects dogs and cattle and is a recognized cause of infertility. Clinical cases have also been reported in horses, goats, sheep, and deer.

Anatomical location: In cattle, the parasite is mainly detected in the brain, heart, and liver of the fetus. In dogs, intracellular tachyzoites and bradyzoites are primarily located in the central nervous system (CNS) and skeletal muscles. In horses, goats, sheep, and deer, the infection predominantly involves the brain, spinal cord, skeletal muscles, and cardiac muscle.

b) *Sarcocystis* species are associated with abortion in cattle.

Anatomical location: The parasite develops within striated muscles, specifically inside the cytoplasm of muscle fibers (intramyofiber).

c) Toxoplasma gondii: Cats are the definitive hosts, while birds and other mammals serve as intermediate hosts in which only the asexual stages occur.

Anatomical location: In cats, sexual development occurs in the epithelial cells (enterocytes) of the small intestine after ingestion of infected tissue. In birds and other intermediate hosts, tissue cysts are commonly found in the heart and skeletal muscles (especially pectoral muscles), brain and nervous tissue, and also in visceral organs such as the liver, spleen, lungs, and kidneys**.**

d) *Tritrichomonas foetus* infects cattle, dogs, cats, and pigs**.** In cattle, it is a flagellated protozoan transmitted during coitus from infected, asymptomatic bulls to cows or heifers. *Tritrichomonas suis* is reported as a gastrointestinal commensal in pigs.

Anatomical location: In cattle, *Tritrichomonas foetus* primarily inhabits the reproductive (urogenital) tract.

Clinical Importance of Anatomical Localization of Parasites in Animals:

Understanding the anatomical localization of parasites in animals is essential in veterinary science because the site of infection directly influences the clinical signs, diagnosis, treatment, and control strategies. Most parasites show a strong preference for specific organs or tissues, and this site specificity determines the type and severity of disease produced.

Conclusion:

Parasites affecting animals exhibit marked tissue and organ specificity, with each species demonstrating a preference for particular anatomical sites within the host. This localization plays a crucial role in determining the clinical manifestations, pathological changes, and severity of disease. A clear

understanding of the anatomical distribution of parasites is therefore essential for accurate diagnosis, effective treatment, and the development of appropriate prevention and control strategies in veterinary practice.

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