Dermatophytes are molds

Tinea is name of disease, not microbe

Systemic fungi
Dimorphic fungi, inhalation of spores from the environment, usually asymptomatic or mild lung infection

- *Coccidioides* – endemic to Southwest US
- *Histoplasma* – endemic to Mississippi/Missouri River valleys

Yeast acquired from environment

- *Cryptococcus* – meningitis

Opportunistic fungi

- *Candida* – yeast, normal flora
  - Thrush, vaginitis, UTI, dissemination

- *Aspergillus* – mold, environmental
  - Serious invasive disease, poor prognosis, difficult to treat

Medical Parasitology – protozoans and helminths

Definitive host – sexual reproduction, intermediate host – asexual reproduction or larval development

Diagnosis of parasitic infections

- Microscopic examination, eosinophilia in tissue helminths

Protozoans: flagellate, amoebas, apicomplexa

Helminths
Disease severity depends on worm loads, worm loads depend on repeated infection

Nematodes

- Intestinal nematodes – usually single host
  - Limited to intestine, or pulmonary migration of larvae

Cestodes – Tape worms

- Flat, segmented body
- Most require multiple host species
- *Taenia saginata* (beef), *Taenia solium* (pork)

Trematodes – Flukes

- All have snail as intermediate host, some have multiple intermediate hosts

- *Schistosoma* – adults inhabit veins as mating pairs
  - Serious disease caused by chronic inflammation associated with retention of eggs
  - *Schistosomiasis* is most important helminthic infection of humans, serious morbidity and mortality.
• Cutaneous and subcutaneous mycoses
  • Cutaneous mycoses
    • Dermatophytosis (tinea, ringworm)
      • tinea capitis (head)
      • tinea corporis (body)
      • tinea cruris (jock itch)
      • tinea pedis (athletes foot)
      • tinea unguium, onycomycosis (nails)
  • Dermatophytes are molds (Trychophyton, Epidermophyton, Microsporum)

• Systemic fungi
  • Dimorphic fungi acquired from environment by inhalation
    • Coccidioides species
      • Dissemination to bones and CNS
    • Endemic to California Central Valley and Southwestern US, Mexico, and South America
  • Histoplasma capsulatum
    • Dissemination to liver and spleen
    • Intracellular survival in macrophages
    • Endemic to Mississippi and Missouri River valleys
  • Yeast acquired by inhalation from environment
    • Cryptococcus immitis
      • Produces antiphagocytic capsular polysaccharide
      • Meningitis
      • Most common fungal infection in AIDS patients

• Opportunistic fungi
  • Candida albicans
  • Yeast
    • Part of the normal human microbiota of the oropharynx, colon and vagina
    • Thrush – superficial oral infection
      • Infants (antibiotics) and immunosuppressed (AIDS patients)
    • Vaginitis
      • Associated with antibiotic use, diabetes, pregnancy
      • Diaper rash
      • In compromised patients
        • Urinary tract infections
        • Blood and disseminated infections

• Opportunistic fungi
  • Aspergillus fumigatus, other Aspergillus species
  • Mold, widespread in the environment
    • Allergic aspergillosis – exacerbation of asthma
    • Serious pneumonia and invasive disease in immunosuppressed persons
    • Poor prognosis, difficult to treat

Medical Parasitology
• The study of protozoans, helminths, and arthropods that produce human disease
  • Protozoans
    • Unicellular heterotrophic eukaryotic organisms
      • Traditionally classified by method of motility
        • Flagellates (flagella-mediated motility)
        • Amoebas (pseudopod-mediated motility)
        • Apicomplexa (no motility)
  • Helminths (worms)
    • Nematodes (round worms)
    • Cestodes (tape worms)
    • Trematodes (flukes, flat worms)

• Life cycles, hosts
  • Many parasites require multiple host species
  • Geographic distribution of human disease may depend on the range of the non-human host
  • Definitive host
    • Host species in which the parasite reproduces sexually
  • Intermediate host
    • Host species in which asexual reproduction or larval development takes place
    • Some parasites require multiple intermediate hosts
• Diagnosis of protozoan and helminthic infections
  • Microscopic examination
    • Feces, vaginal swabs, blood, tissue specimens
  • Complete blood count
    • Eosinophilia is an important characteristic of helminth infections that have a tissue migration stage
  • Serology
    • Antibody detection methodologies for parasites have become more sensitive and specific
  • Antigen detection
    • Protozoan infections
  • Nucleic acid methods
  • Protozoan infections

• Flagellate protozoa
  • Trichomonas vaginalis – vaginitis
  • Giardia lamblia – diarrhea
  • Trypanosoma cruzi – Chagas disease
  • T. brucei – African sleeping sickness
  • Leishmania spp. – mucocutaneous and visceral lesions

• Flagellate protozoa
  • Entamoeba histolytica – diarrhea and liver abscesses
  • Naegleria and Acanthamoeba spp. – amebic meningoencephalitis

• Apicomplexa (old name – Sporozoans)
  • Plasmodium spp. – malaria
  • Toxoplasma gondii – congenital infections and encephalitis
  • Cryptosporidium parvum - diarrhea

Helminths (worms)
• Helminths
  • Multicellular, elongated, bilaterally symmetrical eukaryotic animals
  • Range in size <1 mm to >1 m (human pathogens)
  • All have differentiated organs, nervous system, developed reproductive system (but no circulatory system)
  • May require single or multiple host species
  • Usually do NOT multiply within the host, so increasing “worm load” depends on repeated infections
  • There are a couple of important exceptions involving “autoinfection”
  • Serious disease usually requires high worm load, occurs in the developing world

• Nematodes (round worms)
  • Cylindrical, fusiform shape; tubular alimentary tract with mouth and anus, separate sexes
  • Gastrointestinal nematodes
    • Adult inhabits intestinal tract of host
    • Life cycle can be completed in single host species
    • Eggs or larvae deposited in feces
    • Infections acquired by ingestion of eggs or entry of larvae in skin, depending on species
    • After ingestion and hatching of eggs, larvae may remain in intestine if eggs ingested, or may penetrate gut and enter circulation, or may enter venous circulation from skin
    • Larvae in circulation cannot pass through alveolar capillaries in the lung, break out there, are coughed up and swallowed, and develop into adults in the gut

• Intestinal nematodes
  • Limited to intestine
    • Enterobius vermicularis (pinworm)
      • anal itching (common but not serious)
    • Trichuris trichiura (whipworm)
      • diarrhea, blood loss, rectal prolapse
    • Pulmonary migration
      • Ascaris lumbricoides
        • Eggs ingested
      • Necator americanus (hookworms)
        • Pulmonary symptoms, diarrhea and malabsorption, obstruction
        • Ancylostoma duodenale and Necator americanus (hookworms)
          • Larvae enter skin
        • Skin rash, pulmonary symptoms, anemia
      • Strongyloides stercoralis
        • Larva (not eggs) passed in stool, enter skin
      • Autoinfection possible, larva can migrate in same host, massive hyperinfection can occur in immunosuppressed

• Tissue nematodes
  • Human is natural host, transmission involves arthropod host in which larvae develop
  • Onchocerca volvulus – river blindness
    • Transmitted by fly
    • Adults reside in subcutaneous nodules
    • Larva migrate through skin and eye
    • Chronic inflammation in skin and eye from dying larvae
    • ~300,00 cases of blindness per year, most in sub-Saharan Africa
  • Wuchereria and Brugia – transmitted by mosquitoes
    • Adults reside in lymphatic system, larva enter blood circulation
  • Lymphatic filariasis –obstruction of lymphatic circulation
    • Swelling of tissue, elephantiasis
• Helminths
  • Cestodes – Tape Worms
    • Ribbon shaped, segmented helminth
    • No body cavity or alimentary canal, nutrients absorbed through cuticle
    • Head – scolex, attachment to host intestinal wall
    • Neck – site of generation of proglottid body segments
    • Strobila - proglottids, each with reproductive organs
    • Hermaphroditic – each proglottid has mail and female reproductive organs
    • Most cestode parasites require multiple host species.

Cestodes – Tapeworms

* Taenia saginata – beef tapeworm
  * Humans ingest beef with encysted larvae
  * Larvae develop into adults in infected human
  * Diarrhea, weight loss
  * Humans pass eggs in feces, ingested by cattle grazing on contaminated land

* Taenia solium – pork tapeworm
  * Similar life cycle, except eggs are also infectious for humans
  * Consumption of infected pork – adult worm in human intestine
  * Consumption of egg from human feces – larval cysts in tissue
  * Neurocysticercosis

• Helminths
  • Trematodes – Flukes
    • Bilaterally symmetrical, flattened, leaf-shaped worms
    • Blind alimentary canal
    • Mouth and ventral (for attachment and motility) suckers
    • All have at least one intermediate host, a snail

Trematodes

* Schistosoma hematobium, S. mansoni, S. japonicum – blood flukes
  * Acquired in fresh water, larvae enter skin
  * mating pairs of adults inhabit blood veins
    * S. mansoni, S. japonicum – mesenteric veins (intestine)
    * S. hematobium – bladder veins
  * eggs penetrate walls of vein and migrate to intestinal or urinary tract lumen, passed into fresh water via feces or urine
  * Human disease
    * Skin rash after exposure, headache, fever abdominal pain during larval migration
    * After 1 – 2 months, acute systemic inflammatory illness occurs as adult worms begin depositing eggs
    * Chronic inflammation, hemorrhage, liver and spleen enlargement associated with eggs retained in tissue

• Trematodes
  • Schistosoma
    * Most important helminth pathogen of humans
    * >200 million persons infected, >200,000 deaths per year
    * Occurs in agricultural and fishing populations in developing world
    * Occurs in tropical and subtropical regions world wide, but 90% of infections occur in sub-Saharan Africa
    * Control efforts directed at treatment of at-risk populations, snail control, control of reservoir hosts, and improved sanitation

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