Outline for Parasitology

June 2, 2015 – Samuel Palpant, MD

(Organism genus and species are in purple – May also be disease name)

1. Protozoa
   1. Amoeba – (about the size of WBCs, but move by pseudopodia))
      1. Entamoeba histolytica – obligate human parasite eats RBCs and causes acute dysenteric colitis (fever, blood and mucous in stool) and later liver abscess (hole in liver). Anal and penile disease in MSM patients. Acquired from asymptomatic cyst carriers (not generally from those with active disease). Diagnose stool wet mount/O&P, or stool or serum E. histolytica Ag test (depending on stage GI or extraintestinal disease). Rx with metronidazole (or tinidazole), etc.
      2. Entamoeba coli (one of many non-pathogenic amoeba)
      3. Acanthamoeba – Keratitis in contact lens wearers. Also can cause meningitis.
      4. Naegleria – free living amoeba in pools causing acute and usually fatal meningoencephalitis.
   2. Flagellates (motile)
      1. GI/Vaginal flagellates
         1. Giardia – watery diarrhea, with bloating and foul smell (malabsorption), without fever. Fecal oral spread. Organism is harbored by many rodents and beaver, so campers drinking stream water are at special risk. Increased risk in IgA deficiency. Dx with Giardia antigen or cysts in stool. Rx with metronidazole or tinidazole.
         2. Trichomonas – homogeneous watery discharge and strawberry cervix. Urethritis in men is usually asymptomatic. Sexual transmission. High vaginal pH=5-6 (normal vaginal pH=3.8-4.5) and highly motile cells about the size of WBCs but with flagellum. Rx with metronidazole (or tinidazole).
      2. Blood and Tissue flagellates
         1. Leishmaniasis - transmitted by phlebotomine sandfly. Association with travel to many tropical countries and the Middle East but found widely.
            1. Cutaneous leishmaniasis – L. braziliensis etc. Nonhealing nodules and skin ulcers after travel.
            2. Visceral leishmaniasis (kala azar) – L. donovani. Fever, weight loss, hepatosplenomegaly and pancytopenia. Spleen aspirate shows macrophages filled with organisms (reproducing intracellularly).
            3. Other forms like diffuse cutaneous leishmaniasis (less common)
         2. Trypanosomiasis
            1. T. brucei – African sleeping sickness with East African and West African forms. Tsetse fly causes painful chancre at bite site, then enlarged nodes. Dx by finding flagellated protozoa in blood smear (NOT inside RBCs like malaria and Babesia, but in serum like Borrelia)
            2. T. cruzi – Chagas disease. Armadillo is classic animal reservoir in South and Central America. Transmission by reduviid bug (triatomine/kissing bug) bites at night causing swollen lesion especially around eye (Romaña’s sign). Late disease with megacolon, megaesophagus, and megacardia (megacardia is not a real clinical term, but useful here to describe cardiomyopathy/CHF/arrhythmia). Replicates intracellularly (like sporozoa). Dx with serology. Flagellated protozoa in blood smear (as above but somewhat more C-shaped) are rare and hard to find. Classical xenodiagnosis by infecting reduviid bugs after biting patient with suspected Chagas.
   3. Sporozoa (non-motile protozoa)
      1. GI - Cryptosporidium – obligate intracellular parasite of intestinal epithelial cells. Causes watery diarrhea, worse in AIDS patients. Fecal oral spread (person to person or animal to person) especially from public swimming areas. Not seen on regular O&P study, but stains with modified acid-fast stain.
      2. Blood and Tissue
         1. Malaria - high fever usually related to international travel. Persons returning to visit friends and family are highest risk group. Transmitted by anopheles mosquitoes (or blood transfusion)
            1. P. falciparum –. Causes most fatal cases, cerebral malaria, parasites inside RBCs cause hemolysis. Banana gametocytes. Increased resistance to chloroquine and other antiparasitic drugs except in Central America and Caribbean areas (such as Haiti). Not a relapsing form. Prevention with atovaquone-proguanil (expensive), mefloquine (side effects psychiatric and cardiac), or doxycycline. Therapy with quinine (quinidine), sulfadoxine/pyrimethamine, or artemether combination drugs. Artemether combinations are best for severe malaria.
            2. P. vivax and P. ovale – relapsing forms due to hypnozoites in the liver. P. vivax infects younger RBCs (larger size). P. ovale is only in West Africa. Liver stage for both requires primaquine Rx after treatment of the erythrocytic stage. Check for G6PD deficiency, especially before using primaquine.
            3. P. malariae – infects older RBCs (smaller size).
            4. P. knowlesi – malaria variant seen in South Pacific region (from monkeys).
         2. Babesiosis – looks like malaria with trophozoites in RBCS, but transmitted by ticks and regional disease (especially Minnesota, Wisconsin, and NE USA).
         3. Toxoplasmosis – transmitted by cysts from cat feces and poorly cooked meat. Primary infection in a pregnant woman is a major risk for the fetus (congenital toxoplasmosis) causing mental retardation, chorioretinitis and other birth defects. In normal host it causes fever and mononucleosis-like syndrome, adenopathy, hepatosplenomegaly. Retinitis (blindness that can flair in second and third decade or in immune suppressed. Toxoplasmosis is a common cause of encephalitis with brain cysts especially in AIDS patients. Presents as confusion or seizures, and CT/MRI show ring-shaped brain lesions which enhance with contrast. Serology helpful in dx. Bx shows crescent-shaped trophozoites in macrophages. Rx with sulfadiazine/pyrimethamine.
         4. Pneumocystis – P. jiroveci (previously P. carinii) now classified as fungus (previously protozoan). Classic cause of pneumonia (PCP) in opportunistic host, especially AIDS patients. Presents with fever, SOB and severe hypoxia. No person-to-person transmission. Early in clinical course may have minimal infiltrates on CXR. Dx: biopsy of lung tissue or occasionally sputum may show the oval shaped organism seen with silver stain or immunofluorescent stain. Rx with trimethoprim-sulfamethoxazole or pentamidine. Give prophylaxis for AIDS patients with CD4<200.
2. Nematodes (round worms)
   1. GI Nematodes (some also migrate through tissue)
      1. Enterobius (pin worm) – itchy butt. Scotch-tape test for eggs on anus.
      2. Trichuris (whip worm) – prolapsed rectum.
      3. Ascaris – big round worm (30 cm), very common. Causes intestinal obstruction with worm balls. Also invade appendix or biliary tree. Dx: eggs found in stool or worms seen after Rx. Worms can be coughed up or found in the nose during migration (Loeffler’s eosinophilic pneumonia).
      4. Toxocara (Dog and Cat Ascarids) – Visceral larva migrans in kids who eat dirt (pica) ingesting eggs. Larvae migrate causing fever, eosinophilia, hepatitis, and chorioretinitis. Exudative endophthalmitis mimics retinoblastoma. Dx with serology.
      5. Hookworm (Ancylostoma and Necator) - penetrates intact skin (ground itch), migrates through lung to intestines. Causes asthma like pulmonary disease and eosinophilia during migration. Adult sucks blood from mucosa causing iron deficiency anemia. Dx: eggs in stool. Prevention: wear shoes, improve sanitation.
      6. Dog and Cat Hookworm (Ancylostoma braziliense) – cutaneous larva migrans with itchy linear rash.
      7. Strongyloides – penetrates intact skin, migrates through lung to intestines. Causes asthma like pulmonary disease and eosinophilia during migration. Look for larvae in stool or dx by serology. Larvae hatch before reaching the anus, so no eggs in stool. Larvae penetrate intestinal wall or perirectal area Autoinfection persists for decades. Hyperinfection can be fatal.
      8. Anisakiasis – round worm from raw or undercooked seafood/fish. It causes a terrible “stomach ache” and vomiting when it burrows into the intestinal wall.
   2. Blood and Tissue
      1. Trichinosis (Trichinella spiralis) – reservoir in pigs. Human infection from eating encysted larvae in pork or wild meet such as bear. Causes severe myalgia/myositis. Late stage shows as calcified cysts in muscle. Dx by serology or biopsy. Decreased incidence in US because of prohibition of feeding pigs uncooked garbage, plus meat inspection.
      2. Filaria
         1. Wuchereria bancrofti (or Brugia malayi in Malaysia and SE Asia) –lymphatic filariasis/elephantiasis. Tropical pulmonary eosinophilia. Mosquito vector. Dx by finding microfilaria in night-time blood smear. Serology also helpful.
         2. Onchocerciasis – (Onchocerca volvulus) –. Transmitted by Simulium damnosum black flies that live near rivers (“River blindness”). Skin nodules contain adult worms. Skin is “lizard-like”, itchy and hyperpigmented. Microfilaria in eye cause blindness. Skin snip reveals microfilaria.
         3. Loa loa – eye worm. Transmitted by deer fly
      3. (See Toxocariasis and Cutaneous larva migrans above.)
3. Cestodes (segmented flat worms – “tapeworms”):
   1. Taenia saginata (beef tapeworm) – Man is the definitive host, and cows the intermediate host. Asymptomatic except mild abdominal discomfort, as with most other adult tapeworms. Find proglottids or longer segment of the worm in stool. Find eggs in stool O&P (same appearance as T. solium)
   2. Taenia solium (pork tapeworm) – Man is the definitive host and may be the intermediate host as well.
      1. Adult tapeworm (man as definitive host) – acquired by eating poorly cooked pork with cysticerci (larvae). Generally asymptomatic as other adult tapeworms.
      2. Cysticercosis – (larval tissue phase, with man as intermediate host – usually pig is intermediate host). Acquired by fecal-oral contamination, ingesting eggs from a person with the adult worm. Self infection is possible. Cysts occur in muscles, eye, and brain. Neurocysticercosis (brain lesions) is a common cause of seizures in poor hygiene areas.
   3. Diphyllobothrium latum (fish tapeworm) – Man is the definitive host with small crustaceans and fish as the intermediate hosts. Generally asymptomatic, but associated with B12 deficiency (one of the causes of a macrocytic anemia).
   4. Echinococcosis/Hydatid disease (dog tapeworm) – Dogs are the definitive host and sheep are the usual intermediate hosts. Man can become infected as an intermediate host by fecal oral contamination with eggs from dog feces. Cysts form mostly in liver and lung. Imaging that shows cysts with “daughter cysts” or “hydatid sand” is diagnostic. Prevention: don’t feed sheep viscera to dogs.
4. Trematodes: (non-segmented flat worms – “flukes”)
   1. Schistosomiasis (blood fluke) – A very common parasitic disease with significant morbidity and mortality. Human reservoir (or animal reservoir for some species) with snails in life cycle. Infection occurs when humans are in water and schistosomal cercariae (from snails) penetrate human skin. Prevention by disposing of human waste away from snail habitat. Dry off rapidly after swimming to remove cercaria. Early symptoms with itchy rash after swimming, and later fever, lymphadenopathy and allergic phenomenon related to eggs (Katayama Fever). Eventually a few adult worms live in abdominal venous system for decades, laying eggs that cause liver, colon, or bladder disease. Depending on the species, eggs can rupture to the mucosal surface causing hematuria or rectal bleeding. Stool and urine O&P are not sensitive tests for dx. Serology or biopsy helpful. Rx: praziquantel. Key types include:
      1. S. hematobium (Africa, Middle East) – Man is reservoir, presents with hematuria. Find eggs with terminal barb in a terminal urine sample. Fibrosis and calcifications of the bladder can lead to urinary obstruction and bladder cancer.
      2. S. mansoni (Africa, Middle East, South America), S. japonicum (Asia) – adult blood flukes live in the portal veins and lay eggs that travel to liver or lung causing inflammation and ultimately fibrosis (hepatic schistosomiasis). Children and adolescents present with hepatosplenomegaly related to the egg burden. Chronic hepatic schistosomiasis develops years later with portal hypertension, ascites, splenomegaly, esophageal varices and upper GI bleeding, and sometimes pulmonary hypertension. Liver function is preserved. Association with Salmonella bacteremia from bowel.
      3. Swimmer’s itch from bird schistosomes penetrating skin. No further disease (similar pathogenesis to cutaneous larva migrans from dog hookworm).
   2. Paragonimus (lung fluke) – from eating crabs and crayfish. Presents with hemoptysis and clinical picture like TB, but with eosinophilia.
   3. Clonorchis sinensis/Opisthorchis sinensis (Chinese liver fluke) – Life cycle with man/animals, snails and fish. Human infection from eating freshwater fish (second intermediate host). Adult flukes lives up to 25 years in biliary tree and is generally asymptomatic, but can cause inflammation, and biliary obstruction with jaundice and ascending cholangitis (fever, chills, right upper quadrant abdominal pain). Dx by elevated serum alkaline phosphatase, biliary imaging showing obstruction, eggs in stool, and peripheral eosinophilia in 10-20%. Up to 15 x increased risk for cholangiocarcinoma (biliary tract cancer). In Thailand, nearly all cholangiocarcinomas develop in persons infected with Opisthorchis, usually by age 40-50. Rx: praziquantel. Prevention: Thorough cooking or freezing of freshwater fish.
   4. Fascioliasis – giant liver fluke, similar to Clonorchis but acquired from eating watercress (water plants). Causes “liver rot” in sheep and cattle (definitive host).
5. Ectoparasites:
   1. Arthropod vectors of disease
      1. Mosquito: malaria, lymphatic filariasis, viruses (e.g. equine encephalitis viruses)
      2. Tsetse fly: African trypanosomiasis
      3. Phlebotomine sand fly: leishmaniasis, bartonellosis, viruses
      4. Reduviid bug: Chagas disease
      5. Black fly (Simulium damnosum): onchocerciasis
      6. Deer fly: loiasis (Loa loa)
      7. Hard ticks
         1. *Ixodes* ticks: Lyme disease, babesiosis,
         2. *Other hard ticks:* RMSF, ehrlichiosis, Colorado tick fever
      8. Soft ticks: relapsing fever (Borrelia)
      9. Louse: relapsing fever, rickettsial disease (typhus)
      10. Fleas: *Yersinia pestis* (plague)
   2. Scabies – Human to human spread. Clinical: intensely itchy papular rash (hands, wrists, elbows, webbing between fingers, penis, scrotum), or occasionally diffuse non-pruritic rash in immune suppressed patients (crusted scabies). Secondary bacterial infection is common. Dx: skin scraping or adhesive tape (look for mites, eggs or feces). Rx: lindane, etc.
   3. Lice – Three types: Head louse, body louse and pubic louse (“crab louse”, also found in eyebrows). Frequent secondary infection. Dx: find nits (eggs) firmly attached to hair. Rx: topical agents and combing nits out.
   4. Myiasis – invasive fly larva from eggs lain on clothing etc. Lesions look like folliculitis or scattered small abscesses.
   5. Bed bugs – itchy rash. No proven transmission of diseases (although some speculation). Bites may be grouped or in lines (breakfast, lunch and dinner).
   6. Insect bites: Chiggers, biting midges (no-see-ums), flea bites – often cause very itchy papular rashes or urticaria.

**Examples of Dendritics:**

* Types of Host:
  + Definitive host: An organism harboring the adult or sexual stage of the parasite.
    - Reservoir host: Animals may harbor the same parasite species as man and serve as a reservoir. In diseases more exclusive to humans, man is the reservoir host.
    - Incidental host: An unusual definitive host; one that is not necessary for the maintenance of the parasite in nature.
  + Intermediate host: An organism in which the larval or asexual form of the parasite undergoes a process of development.
  + Dead-end host: A host that doesn’t pass the parasite to another host.
* Parasites with humans as the primary reservoir host: Plasmodium, Trichomonas, Wuchereria, Taenia, Schistosomes, Clonorchis etc. (Non-parasitic examples include AIDS, Hepatitis, Group A Streptococci, Typhoid Fever, and Gonorrhea.)
* Mosquito-bourne diseases:
  + Parasites - Malaria, Filaria
  + Viruses –
    - Dengue, Chikungunya, Yellow Fever
    - ARBO-virus encephalitis (West Nile, Eastern Equine, Western Equine, St. Louis, LaCrosse, Japanese encephalitis).
    - Others viruses include Rift Valley Fever and Ross River Fever Virus, etc.
* Parasites that enter through the skin without an arthropod bite: Hookworm (Necator and Ancylostoma -including cutaneous larva migrans from dog hookworm), Strongyloides, Schistosomiasis, Myiasis.
* Fish transmitted diseases: Clonorchis, Diphyllobothrium, Anisakiasis,
* Fever after travel in the topics:
  + Common Potentially Critical Illness (Malaria, Dengue, Typhoid, Trypanosoma)
  + Less Critical but Common (Pneumonia, UTI, Hepatitis, Mononucleosis, Rickettsia, STDs)
* Meningitis:
  + Bacteria: Pneumococcus, Meningococcus, Haemophilus influenza, Tuberculosis
  + Fungus: Cryptococcus,
  + Virus: Herpes simplex, polio virus, Enteroviruses, etc,
  + Non-infectious or unknown causes (NSAID-induced, malignant, Behçet’s, etc)
* Pharyngitis:
  + Common: Group A Strep, Group C & G Strep, EBV, Influenza,
  + Less Common: Coxsackie, STDs (HSV,HIV, Gonorrhea), Candida,
  + Rare, but important causes: Diphtheria, Fusobacterium)
  + Non-infectious causes: Allergies, Smoking, GERD
* Vaginitis/Cervicitis:
  + Bacterial vaginosis (foul smelling, homogeneous discharge, vaginal pH>4.5, clue cells)
  + Candida vulvovaginitis (pruritus, curd-like discharge, vaginal pH=4-4.5, KOH positive)
  + Trichomoniasis (foamy discharge, vaginal pH5-6, strawberry cervix, wet mount positive)
  + Atrophic vaginitis and other non-infectious causes
  + Gonorrhea/Chlamydia and Herpes simplex cause cervicitis more than vaginitis
* Heart Muscle disease: Chagas Dz, Trichinosis, Toxoplasmosis, Coxsackie, Diphtheria
* Infections of the eye: Bacteria (Trachoma, TB), Virus (Herpes simplex), Fungus (Candida endophthalmitis, Mucormycosis rhinosinusitis-periorbital infection in diabetics, Parasites (Toxoplasmosis, Onchocerciasis, Loiasis).
* Lymphocutaneous syndrome (bumps or ulcers along lymphatic drainage): Sporotrichosis, Atypical Mycobacteria (M. marinum), Nocardia, or Cutaneous Leishmaniasis.
* Splenomegaly (Infectious etiologies): Bacteria (endocarditis, brucellosis), Virus (EBV, HIV, etc), Fungus: Histoplasmosis, Parasites (malaria, leishmaniasis, schistosomiasis, toxoplasmosis)