

Biology 201
Tropical Protozoa

Introduction to Protozoa Kingdom

DNA data suggests actually several kingdoms.

Some Key, Relevant Features

Unicellular eukaryotes - so which domain?
No tissues/organs, but do show development
Metabolism: chemicals for energy
Most reproduce sexually or asexually

Major Phyla - Motility-Driven (sort of)

Old Flagellates: no organelles, maybe later - GI

New Flagellates: Leishmania, Trypanosoma

Amoebae: maybe later - GI

Ciliates: maybe later - GI

Sporozoa (non-motile): Plasmodium

New Flagellates

Genus 1 - Leishmania

About 30 genera, 20 pathogenic
Carried by tropical sandflies - on dogs, rats...
In insect: promastigote - flagella, extracellular
In human: amastigote - non-motile, intracellular
4 species, 3 distinct diseases or regions

Leishmaniasis 1: Cutaneous

Insect bite injects agent just below skin surface
Infect white blood cells - lesions, scars, resolves
New World mexicana - Latin America
Old World tropica - Asia, Africa, Middle East

Leishmaniasis 2: Mucocutaneous

More invasive braziliensis - Latin America
Like cutaneous but deeper, melts nose, mouth
Secondary infections, fever, more scarring

Leishmaniasis 3: Visceral or Kala Azar

Most invasive donovani - tropics/subtropics
Skin to white blood cells - no symptoms for years
Then, fever, gray skin, hepatosplenomegaly
75-90% lethal if untreated; 30% lethal if treated

Leishmaniasis - Epidemiology, Treatment

350 million worldwide; 2 million new cases/year
Military problem - Iraq, Afghanistan, Columbia
Unique outer membrane molecule - LPG
Antimony drugs target LPG - toxic side effects

Genus 2: Trypanosoma

2 major species, insect vectors, diseases
In insect: epimastigote - small sail flagella,
In human: trypomastigote - full sail flagella
Some evidence of amastigotes - chronic cases

American Trypanosomiasis/Chagas

T. cruzi discovered 1909, taken seriously 1960s
Assassin/kissing bug (chinchas) carries in feces
Animal and dwelling-associated - thatch roof...
Feces/agent enters bites on face - "el barbeiro"
Also via blood/organ donors, mother-infant

Both Chagas, Cruzi = Brazilian epidemiologists in early 1900s - major public health heroes.

Chagas - The Disease

Through bite, agent invades to blood slowly...
2 Stages - acute (months), chronic (10 years)
Acute: no symptoms, or skin/eye swelling...
fever, hepatosplenomegaly, myocarditis
Chronic: permanent damage to heart (30%)...
GI (15%), nervous system (<10%)

20% acute resolve on own - seldom young/old.

Chagas - Epidemiology, Treatment

Latin America: 16-18 million affected annually
Up to 50,000 die each year - fatal if untreated
10% rural population show heart defects
Nifurtimox reduces acute cases - NOT chronic
Target is DNA in dividing cells - BIG side effects
Most programs - homes, insecticides, education

US blood not screened, not notifiable, about 50,000 immigrants infected.

African Trypanosomiasis/Sleeping Sickness

T. brucei - 2 strains: gambiense, rhodesiense
Carried by Tse Tse fly/Glossina salivary glands
TBG - "riverine" flies, humans main host
TBR - savannah, antelopes main host
Also via blood/organ donors, mother-infant

Although recognized and dealt with early (1910) - serious surveillance lapses... re-emerging!!!

Sleeping Sickness - The Disease

Following bite/lesion, depends on strain...
TBG: chronic, asymptomatic/fever 6-9 months
TBR: acute, asymptomatic 3-6 weeks
Major Symptoms - organ failure, crosses BBB...
Convulsions, sleeping, insomnia, speech loss

Sleeping Sickness - Epidemiology, Treatment

0.5 million infected/year - TBG/West; TBR/East
Up to 40,000 die/year, 20,000 acquire/year
Ongoing epidemics - Uganda, Congo Basin
5-10 tourists/20,000 acquire/year - most TBR
Suramin pre-brain; Arsobal post-brain symptoms

Suramin targets unique protozoa metabolic

reactions (safer); arsobal = toxic arsenic

Sporozoa - Also Apicomplexa

Plasmodium

Several geographically distinct species
Carried by tropical Anopheles mosquito saliva
Extremely complex life cycle - will not cover all
In insect: various extracellular forms
In host: various intracellular forms - liver, blood

Malaria - The Disease

2 weeks following bite/lesion, most strains...
Infection sites = red blood cells (RBC), liver
Periodic Fever - 48-72 hours (strain-dependent)
Anemia - RBC killing, dark urine/blackwater fever
Circulation - vasodilation, pressure differences
Organ Complications - liver, kidney, spleen

While many resolve, others - chronic liver or fatal brain infections.

Malaria - Epidemiology

#5 Killer, 1-3 million die annually, 80-90% Africa
300-500 million cases annually worldwide
vivax: tropics and subtropics, most widespread
falciparum: only equatorial tropics
ovale: primarily Africa, some Asia

Malaria - Sickle Cell Disease Connection

Genetic disease that protects against malaria
Defective hemoglobin halts RBC infection
Each person get 2 gene copies - H/good, h/SC
SO - 3 Kinds of People: HH, hh, Hh (carriers)
In malaria areas, carriers (Hh) survive best
25% tropical race maintain sickle cell gene

Meanwhile, HH more susceptible to malaria, hh die from full-blown sickle cell.

Malaria - Treatment

Most drugs based on plant-derived compounds
S. American Cinchona bark, Chinese Artemisia
Chloroquine - target rapidly dividing agent DNA
Artemisinin - break down agent membranes
Mounting resistance, not unique to malaria

Some drugs for treatment post-infection; others for prophylaxis to avoid infection.