Unit 5 Lecture 13

Miscellaneous Bacteria

Vibrio cholerae is a <u>curved halophilic bacillus</u>. It is motile with a single polar flagellum. *V. cholera* causes the disease called cholera. Currently the world is in the seventh vibrio pandemic since 1817. The POE is GI tract. Organisms do not invade tissues. Cholera toxin (endotoxin) causes rapid, severe diarrhea by stimulating loss of CI⁻ and HCO₃⁻ ions which is followed by water loss. Dehydration is due to loss of 15-20 liters per day of watery stools that have a rice water appearance. Loss of fluids and electrolytes causes the person to go into metabolic acidosis, creates an electrolyte imbalance, and hypokalemia. Transmission is fecal/oral. Carriers are rare. Mortality is >60% in untreated cases but falls to less than 1% when fluids and electrolytes are restored.

Treatment consists most importantly of fluid and electrolyte replacement. Tetracycline is used to kill the bacterial population. A killed vaccine is available for high risk personnel and epidemics; the vaccine has short-life vaccine via IgA protection.

Campylobacter jejuni is another curved gram negative bacilli, often seen in 'gull-winged' appearance microscopically. Campylobacter exhibit a darting motility. They require a microaerophilic atmosphere and special media to grow. Growth at 42° C inhibits other organisms. The pathology of the disease is one of a bacterial gastroenteritis due to enterotoxin production. Symptoms include bloody or watery diarrhea, fever, and abdominal pain. Transmission is via contaminated food (especially poultry) and water. Treatment is with erythromycin, tetracycline, or fluroquinolones in severe cases and replacement of fluids and electrolytes in mild cases. No vaccines are available.

Mycoplasma pneumoniae is a pleomorphic organisms that is not gram stained because the cell has no cell wall. Special stains are used to visualize the organism. It is nonmotile and is cultured on special media with penicillin (which kills other cell walled organisms). *Mycoplasma pneumoniae* causes primary atypical pneumonia (PAP) which is also known as walking pneumonia. The patient will exhibit fever, malaise, sore throat and headache. The organism is a respiratory membrane parasite and causes a non-productive cough. There is no phagocytic response and little exudates in lungs. Mostly it is an asymptomatic infection. Transmission occurs most likely in close quarters via aerosolized droplets. Cattle are reservoirs of all species of Mycoplasma. Treatment is with erythromycin and tetracycline. Vaccines are not available. Because growth is so slow (2-4 weeks), PCR assay are the diagnostic tool of choice.

Rickettsia, Orientia & Chlamydia

Rickettsias are gram-negative pleomorphic coccobacillus or diplobacillus. They too are stained with Giemsa or other intracellular stains. Since they are obligate intracellular parasites they will not grow on artificial media and require embryonated eggs, small laboratory animals, or tissue cultures. Some examples of rickettsial diseases and their causative agents are:

Epidemic (classical) typhus - *Rickettsia prowazeki* Endemic (murine) typhus - *R. typhi* Scrub typhus (tsutsugamushi) - *Orientia tsutsugamushi* Rocky Mountain <u>spotted fever</u> (tick-borne typhus) – *R. rickettsii* Rickettsial pox - *R. akari.*

Transmission is by insect vectors [body lice (typhus), ticks (spotted fever) or fleas] to people living in crowded conditions or who have come in contact with the vector. The POE is via fecal-infection from lice & fleas; bite of wood and dog ticks. Blood vessel dissemination and multiplication is immediate. The infected person demonstrates a severe headache, sudden fever, chills and muscle pain. Rash



patterns are diagnostic of variety and often appear about a week after the bite. In some cases the patient exhibits small hemorrhages and/or clotting. Untreated diseases are often fatal due to circulatory or renal collapse but virulence is variable by species. There is no transmission from human to human. There is permanent immunity for survivors. Species are often separated geographically. Diagnosis is made using the Weil-Felix test which is a battery of serological tests. Antibodies from all diseases react, so one must look for patterns. Treatment is with broad-spectrum antibiotics. Vaccines are available for epidemic typhus; but not for Rocky Mountain spotted fever at this time. Rats, cats, rabbits, and small rodents serve as reservoirs.

Chlamydia is a gram-negative obligate intracellular parasite. It has a unique life cycle (possess a metabolically inert, infectious form and an intracellular form: elementary body and reticulate body. They are grown on living media such as embryonated eggs and in tissue culture. Chlamydia is an energy parasite because it uses the host cell ATP for its own energy requirements. The method of infection and reproduction is described as follows. An inactive 'elementary body' is adsorbed onto membrane, is phaegocytized by the tissue cell. The organism develops into a reticulate body and undergoes multiple binary fission within the host cell. The intracellular colony lyses cell releasing other elementary bodies to infect other cells. C. trachomatis types A, B, and C infections cause trachoma of the conjunctiva and keratitis of the cornea. This organism is the world's major cause of blindness. Transmission occurs in unsanitary conditions by direct contact. Treatment is with broad spectrum antibiotics. Man is only host. C. trachomatis types D-K result in non-gonococcal urethritis (NGU). This is a mild urethral infection in the male. In the female infections are often asymptomatic (leading cause of PID). It is estimated that 10% of all people have the infection which can lead to sterility in the adult and conjunctivitis or dangerous pneumonia in infants. Transmission is by direct contact. Treatment is with broad spectrum antibiotics. Humans are the only host. Infection with *C. trachomatis* type L results in lymphogranuloma venereum (LGV). It produces nonspecific lesions of the genitals, buboes in the lymph nodes in inguinal area. Transmission is by venereal contact. Treatment is with broad spectrum antibiotics. Man is only host.

Chlamydophila psittaci infections cause ornithosis (psittacosis). Often this infection is misdiagnosed as influenza or pneumococcal pneumonia. Secondary infections of meningitis, brain, heart, liver can occur. The POE is respiratory tract via aerosols. Treatment is with Tetracycline. The reservoir is psittacine (macaws and parrots).

Chlamydophila pneumoniae infections cause a bronchitis, pneumonitis, and self-limiting pharyngitis. It has recently been associated with a chronic infection in the arterial walls and as a result a contributing factor for arterial disease (atherosclerosis).

Spirochetes

Treponema pallidum is a spirochete. A silver or Giemsa stain is required to see the organism microscopically since the organism doesn't take Gram stain. This spirochete is flexible with regularly-spaced coils. It is motile by means of axial filament. The disease caused by T. *pallidum* is syphilis. Syphilis is usually acquired by direct sexual contact: however it can be contracted by other means. The



incubation period is usually 3-4 weeks during which the organisms multiply at site of contact. Lymphatic invasion usually occurs. In primary syphilis a hard chancre develops at site(s) of infection. A non-painful shallow ulcer develops and contains organisms that spontaneous healing without scars in 2-3 months. The primary latent stage exists for 1-2 months and then moves to secondary syphilis. Lesions develop from dissemination on the mucous membranes and a macular rash develops on the skin. Organisms are present in primary and secondary lesions and the infected person is quite contagious. Secondary lesions often heal spontaneously within 5 months and the infected individual enters another latent stage in which no signs of disease are present, organisms cannot be located, but antibodies can be detected if organisms are still present. This stage may last 6 years to lifetime. In tertiary syphilis various types of permanent damage result from the granulomatous lesion (gumma). There is localized destruction in the skin, aorta, bones, liver, etc. If the CNS is involved, mental deterioration [Tabes dorsalis (in the dorsal columns of spinal cord)] occurs. Diagnosis is made by dark-field direct examination sometimes. Most often screening tests such as the VDRL (Venereal Disease Research Lab) or RPR (antibody flocculation test) tests are used to detect antibodies. False positives occur because of the reaction with non-specific antibody. Reagenic antibodies are produced by patients against various organisms, non-infectious conditions, and recent immunizations. All positive screening tests should be confirmed with the FTA (fluorescent treponemal antibodies against antigens of the organism). Syphilis is acquired venereal.

Congenital syphilis is due to placental transmission of organisms. Primary and secondary stages are only seen and result in stillbirth and nervous system abnormalities. There is no permanent immunity and no vaccine. The organism is very sensitive to penicillin. Other treponemal diseases include Bejel, Yaws, and Pinta.

Borrelia burgdorferi is a gram-negative spirochete. This organism is a strict anaerobe that causes Lyme's disease. The initial lesion is a spreading <u>bulls-</u> <u>eye</u> (70%). Other symptoms include headache, fever, muscle aches, and flulike symptoms. Arthritis and/or CNS disorders may occur months to years later. Placental transmission may cause miscarriage or stillbirths. The POE is via the bite of an infected <u>deer tick</u> (Ixodes). Penicillin, tetracycline, or a third generation cephalosporin can cure if used early in the disease. Two vaccines are tentatively approved for humans.

Borrelia hermsii causes relapsing fever and is spread by infected lice and ticks bites.

Leptospira interrogans is a gram-negative spirochete. This strict aerobe



shepherd's-crook exhibits the typical coil Symptoms microscopically. of Leptospirosis (infectious jaundice) occur after a 8-12 day incubation. Chills, fever, headache, muscular pain, aseptic meningitis along with liver and kidney destruction occur. There are subcutaneous hemorrhages (icteric leptospirosis). The POE is the mucosa or skin breaks (drinking contaminated conjunctiva) or water, by ingestion of contaminated water with animal urine (zoonosis).

Treatment is with penicillin, streptomycin and tetracycline. Vaccines are available for pets and humans.

Helicobacter pylori are a gram-negative spirillum. A single, polar flagellum (virulence factor, allows organism to burrow into mucosa). The organism produces urease (allows organism to survive in acid environment of stomach). It causes gastric and duodenal ulcers. This organism is a widespread pathogen in many mammals that is an opportunist when HCI

decreases. Clarithromycin and metronidazole are effective in treatment. Helicobacter is transmitted by oral-oral or fecal-oral route.

Property	"Typical" Bacteria	Rickettsia	Chlamydia	Viruses
Size	0.5- 5 µm	0.3-3 µm	0.2-1.5 μm	0.02-0.3 μm
Parasitic means	Primarily Extracellular	Obligate Intracellular	Obligate Intracellular	Obligate Intracellular
Possess Enzymes	Complete	Incomplete	Incomplete	No
Produce ATP	Yes	No	No	No
Ribosomes	Yes	Yes	Yes	No
Nucleic acid	DNA & RNA	DNA & RNA	DNA & RNA	DNA or RNA
Means of Reproduction	Binary fission	Binary fission	Multiple fission	Replication
Murein & Lipid	Yes	Yes	Yes	No
Gram Reaction	Pos. & Neg.	Neg.	Neg.	N.A.
Antibiotic inhibition	Yes	Broad spectrum	Broad spectrum	Actinomycin

Summary of Variation by Groups