**Lecture 5.**

***Pathogenic Spirochetes, Rickettsiae, Chlamydiae and Mycoplasma***

**The purpose of the lecture:** To provide information on the morpho-biological characteristics of spirochetes, rickettsiae, chlamydia and mycoplasmas, pathogenic factors, pathogenesis of diseases caused by these microorganisms, the main clinical signs, microbiological diagnosis, treatment and prevention principles.

**Lecture plan:**

1. Pathogenic spirochetes. General characteristics, classification.

- *Treponemas*. The causative agent of syphilis, morpho-biological characteristics, antigen structure, virulence factors, pathogenesis. The causative agents of syphilis-like diseases (frambezia, pinta). Principles of microbiological diagnostics. Principles of treatment of syphilis.

- *Borrelia*. The causative agents, morpho-biological characteristics, virulence factors, pathogenesis. Microbiological diagnostics. The causative agent of Lyme disease, the pathogenesis of the disease. Microbiological diagnostics.

- *Leptospirosis*, morpho-biological characteristics, classification. Source of infection, mode of transmission, pathogenesis, microbiological diagnosis, principles of specific treatment and prevention.

2. Pathogenic rickettsiae, morpho-biological characteristics. Classification of rickettsioses.

- Causes of typhus group (Rickettsia prowazekii, Rickettsia typhi), virulence factors, pathogenesis and microbiological diagnosis. Principles of specific treatment and prevention.

- Pathogenesis and microbiological diagnosis of diseases caused by spotted fever group rickettsiae (rocky mountain spotted fever - *R.rickettsii*, Marseille fever - *R.conorii*, flower-like rickettsiosis - *R.akari*, North Asian tick-borne rickettsiosis - *R.sibirica*).

- *Orientia tsutsugamushi* – Scrub typhus or Bush typhus, morpho-biological characteristics, pathogenesis and microbiological diagnosis.

- Genus Ehrlichia (monocytic ehrlichiosis – *E.sennetsu, E.chaffeesis*, granulocytic ehrlichiosis – *E.ewingii*, Anaplasma phagocytophilum), morpho-biological characteristics, pathogenesis and microbiological diagnosis of the diseases they cause

- The causative agent of Q-fever (*Coxiella burnetii*), morpho-biological characteristics, pathogenesis and microbiological diagnosis.

3. Pathogenic chlamydia, classification, morpho-biological characteristics.

- *Chlamydia trachomatis*, serotypes, characteristics of diseases caused by individual serotypes, pathogenesis. Microbiological diagnostics.

- *Chlamydia psittaci* – the causative agent of ornithosis. Pathogenesis of the disease in man. Microbiological diagnostics.

- *Chlamydia pneumonia*, its role in human pathology. Pathogenesis and microbiological diagnosis of the disease caused by it.

4. Pathogenic mycoplasmas, morpho-biological characteristics.

- *Mycoplasma* genus, morpho-biological characteristics, classification. Pathogenicity factors. Human diseases. Microbiological diagnostics.

- *Ureaplasmas*, morpho-biological characteristics. Role in urogenital infections and pregnancy pathology. Microbiological diagnostics.

The bacteria in the order Spirochaetales have been grouped together on the basis of their common morphologic properties. These spirochetes are thin, helical (0.1 to 0.5 × 5 to 20 μm), gram-negative bacteria. The order Spirochaetales is subdivided into 4 families and 14 genera, of which 3 genera (*Treponema* and *Borrelia* in the family Spirochaetaceae, and *Leptospira* in the family Leptospiraceae) are responsible for human disease.

***TREPONEMA PALLIDUM***

**Trigger Words**

Thin spirochete, sexually transmitted disease, congenital infections, painless ulcer (chancre)

**Biology and Virulence**

ᑏᑏ Coiled spirochete (0.1 to 0.2 × 6 to 20 μm) too thin to be seen with Gram or Giemsa stains; observed by darkfield microscopy

ᑏᑏ Outer membrane proteins promote adherence to host cells

ᑏᑏ Hyaluronidase facilitates perivascular infiltration

ᑏᑏ Coating of fibronectin protects against phagocytosis

ᑏᑏ Tissue destruction primarily results from host’s immune response to infection

**Epidemiology**

ᑏᑏ Humans are the only natural host

ᑏᑏ Syphilis transmitted by sexual contact or congenitally

ᑏᑏ Syphilis occurs worldwide, with no seasonal incidence

**Diseases**

ᑏᑏ Syphilis presents as primary disease (painless ulcer [chancre] at site of infection, with regional lymphadenopathy and bacteremia), secondary syphilis (flulike syndrome with generalized mucocutaneous rash and bacteremia), and late-stage disease (diffuse chronic inflammation and destruction of any organ or tissue); congenital (latent multiorgan malformations, fetal death)

**Diagnosis**

ᑏᑏDarkfield or direct fluorescent antibody microscopy is useful if mucosal ulcers are observed in primary or secondary stages of syphilis

ᑏᑏ Serology is very sensitive in secondary and late stages of syphilis

**Treatment, Prevention, and Control**

ᑏᑏ Penicillin is the drug of choice; doxycycline is administered if patient is allergic to penicillin

ᑏᑏ Safe sex practices should be emphasized, and sexual partners of infected patients should be treated

ᑏᑏ No vaccine is available

***BORRELIA***

**Trigger Words**

Large spirochetes, erythema migrans, Lyme disease, relapsing fever, hard and soft ticks, body louse

**Biology and Virulence**

ᑏᑏ Borreliae are large (0.2 to 0.5 × 8 to 30 μm) and can be seen when stained with aniline dyes (e.g., Giemsa, Wright stains)

ᑏᑏ Immune reactivity against Lyme disease agents may be responsible for clinical disease

***EPIDEMIOLOGY***

**Lyme Disease**

ᑏᑏ *B. burgdorferi* causes disease in the United States and Europe; *B. garinii* and *B. afzelii* cause disease in Europe and Asia

ᑏᑏ Transmitted by hard ticks from mice to humans; reservoirs include mice, deer, and ticks; vectors include *Ixodes scapularis* in eastern and midwestern United States, *I. pacificus* in the western United States, *I. ricinus* in Europe, and *I. persulcatus* in Eastern Europe and Asia

ᑏᑏ Most Lyme disease cases in the United States are from two principal foci: Northeast and Mid-Atlantic states (Maine to Virginia) and the Upper Midwest (Minnesota, Wisconsin)

ᑏᑏ Individuals at risk for Lyme disease include people exposed to ticks in areas of high endemicity

ᑏᑏ Worldwide distribution

ᑏᑏ Seasonal incidence corresponds to feeding patterns of vectors; most cases of Lyme disease in the United States occur in late spring and early summer (feeding pattern of nymph stage of ticks); peak in June and July

**Epidemic Relapsing Fever**

ᑏᑏ Etiologic agent is *B. recurrentis*

ᑏᑏ Person-to-person transmission; reservoir includes humans; vector includes human body louse

ᑏᑏ Individuals at risk are people exposed to lice (epidemic disease) in crowded or unsanitary conditions

ᑏᑏ Occurs in Ethiopia, Eritrea, Somalia, and Sudan

**Endemic Relapsing Fever**

ᑏᑏ Many *Borrelia* species are responsible

ᑏᑏ Transmitted from rodents to humans; reservoirs include rodents, small mammals, and soft ticks; vector includes soft ticks

ᑏᑏ Individuals at risk are people exposed to ticks (endemic disease) in rural areas

ᑏᑏ Worldwide distribution; in the western part of the United States

**Diseases**

ᑏᑏ Borreliae are responsible for two human diseases: Lyme disease and relapsing fever (epidemic and endemic)

ᑏᑏ *Borrelia* species responsible for relapsing fever are able to undergo antigenic shift and escape immune clearance; periodic febrile and afebrile periods result from

antigenic variation

**Diagnosis**

ᑏᑏ Serology is test of choice for Lyme disease

ᑏᑏ Polymerase chain reaction tests available for Lyme disease but relatively insensitive

ᑏᑏMicroscopy is the test of choice for diagnosis of relapsing fever

**Treatment, Prevention, and Control**

ᑏᑏ For early localized or disseminated Lyme disease, treatment is with amoxicillin, tetracycline, cefuroxime; late manifestations are treated with intravenous penicillin or ceftriaxone

ᑏᑏ For relapsing fever, treatment is with tetracycline or erythromycin

ᑏᑏ Improved sanitary conditions to decrease risk of epidemic relapsing fever

ᑏᑏ Reduced exposure to hard ticks (Lyme disease) and soft ticks (relapsing fever) through use of insecticides, application of insect repellents to clothing, and wearing protective clothing that reduces exposure of skin to insects

***LEPTOSPIRA***

**Trigger Words**

Thin, spirochetes, flulike disease, aseptic meningitis, Weil disease, zoonotic, contaminated water exposure

**Biology and Virulence**

ᑏᑏ Thin, coiled spirochetes (0.1 × 6 to 20 μm) that grow slowly in specialized cultures

ᑏᑏ Able to directly invade and replicate in tissues, inducing an inflammatory response

ᑏᑏ Immune complex produces renal disease (glomerulonephritis)

ᑏᑏ Most disease is a mild virus-like syndrome

ᑏᑏ Systemic leptospirosis presents most commonly as aseptic meningitis

ᑏᑏ Over whelming disease (Weil disease) is characterized by vascular collapse, thrombocytopenia, hemorrhage, and hepatic and renal dysfunction

**Epidemiology**

ᑏᑏ US reservoirs: rodents (particularly rats), dogs, farm animals, and wild animals

ᑏᑏ Humans: accidental end-stage host

ᑏᑏ Organism can penetrate the skin through minor breaks in the epidermis

ᑏᑏ People are infected with leptospires through exposure to water contaminated with urine from an infected animal or handling of tissues from an infected animal

ᑏᑏ People at risk are those exposed to urine-contaminated streams, rivers, and standing water; occupational exposure to infected animals for farmers, meat handlers, and veterinarians

ᑏᑏ Infection is rare in the United States but has worldwide distribution

ᑏᑏ Disease is more common during warm months (recreational exposure)

**Diagnosis**

ᑏᑏMicroscopy not useful because too few organisms are generally present in fluids or tissues

ᑏᑏCulture blood or cerebrospinal fluid in the first 7 to 10 days of illness; urine after the first week

ᑏᑏ Serology using the microscopic agglutination test is relatively sensitive and specific but not widely available in resource-limited countries; enzymelinked immunosorbent assay tests are less accurate but can be used to screen patients

**Treatment, Prevention, and Control**

ᑏᑏ Treatment with penicillin or doxycycline

ᑏᑏ Doxycycline but not penicillin is used for prophylaxis

ᑏᑏ Herds and domestic pets should be vaccinated

ᑏᑏ Rats should be controlled

**Medically Important Genera in the Order Spirochaetales**





Diagnostic Tests for Syphilis



**Conditions Associated with False-Positive Serologic Test Results for Syphilis**

**Nontreponemal Tests**

Viral infection

Rheumatoid arthritis

Systemic lupus erythematosus

Acute or chronic illness

Pregnancy

Recent immunization

Drug addiction

Leprosy

Malaria

Multiple blood transfusions

**Treponemal Tests**

Pyoderma

Rheumatoid arthritis

Systemic lupus erythematosus

Psoriasis

Crural ulceration

Skin neoplasm

Drug addiction

Mycoses

Lyme disease

Acne vulgaris

**Epidemiology of *Borrelia* infections.**



**Definition of Lyme Disease**

**Clinical Case Definition**

Either of the Following:

Erythema migrans (≈5 cm in diameter)

At least one late manifestation (i.e., musculoskeletal, nervous system, or cardiovascular involvement) and laboratory confirmation of infection

**Laboratory Criteria for Diagnosis**

At Least One of the Following:

Isolation of *Borrelia burgdorferi*

Demonstration of diagnostic levels of IgM or IgG antibodies to the spirochetes

Significant increase in antibody

**Bacteria and Diseases Associated with Cross-Reactions in Serologic Tests for Lyme Borreliosis**

*Treponema pallidum*

Oral spirochetes

Other *Borrelia* species

Juvenile rheumatoid arthritis

Rheumatoid arthritis

Systemic lupus erythematosus

Infectious mononucleosis

Subacute bacterial endocarditis

***RICKETTSIA RICKETTSII***

**Trigger Words**

Intracellular bacteria, Rocky Mountain spotted fever, vasculitis, tick, micro immunofluorescence test

**Biology and Virulence**

ᑏᑏ Small intracellular bacteria

ᑏᑏ Stain poorly with Gram stain; best with Giemsa or Gimenez stains

ᑏᑏ Replication occurs in cytoplasm and nucleus of endothelial cells, with resulting vasculitis

ᑏᑏ Intracellular growth protects the bacteria from immune clearance

**Epidemiology**

ᑏᑏ *R. rickettsii* is the most common rickettsial pathogen in the United States

ᑏᑏ Hard ticks (e.g., dog tick, wood tick) are the primary reservoirs and vectors

ᑏᑏ Transmission requires prolonged contact

ᑏᑏ Distribution in Western Hemisphere; in United States, the majority of infections are reported in five states: North Carolina, Oklahoma, Arkansas, Tennessee, and Missouri

ᑏᑏ Disease is most common from April through September

**Diseases**

ᑏᑏ Rocky Mountain spotted fever characterized by high fever, severe headache, myalgias, and rash; complications common in untreated patients or where diagnosis is delayed

**Diagnosis**

ᑏᑏ Serology (e.g., microimmunofluorescence test) is used most commonly for diagnosis

**Treatment, Prevention, and Control**

ᑏᑏ Doxycycline is the drug of choice

ᑏᑏ People should avoid tick-infested areas, wear protective clothing, and use effective insecticides

ᑏᑏ People should remove attached ticks immediately

ᑏᑏ No vaccine is currently available

***RICKETTSIA PROWAZEKII***

**Trigger Words**

Intracellular bacteria, louse-borne typhus, Brill-Zinsser disease, vasculitis, human reservoir, micro immunofluorescence test

**Biology and Virulence**

ᑏᑏ Small intracellular bacteria

ᑏᑏ Stain poorly with Gram stain; best with Giemsa or Gimenez stains

ᑏᑏ Replicate in cytoplasm of endothelial cells, with resulting vasculitis

ᑏᑏ Intracellular growth protects the bacteria from immune clearance

**Epidemiology**

ᑏᑏ Humans are the primary reservoir, with person-to-person transmission by louse vector

ᑏᑏ It is believed that sporadic disease is spread from squirrels to humans via squirrel fleas

ᑏᑏ Recrudescent disease can develop years after initial infection

ᑏᑏ People at greatest risk are those living in crowded, unsanitary conditions

ᑏᑏ Disease is worldwide, with most infections in Central and South America and Africa

ᑏᑏ Sporadic disease is seen in the eastern United States

**Diseases**

ᑏᑏ Epidemic typhus (louse-borne typhus) characterized by high fever, severe headache, and myalgias

ᑏᑏ Recrudescent typhus (Brill-Zinsser disease) is a milder form of the disease

**Diagnosis**

ᑏᑏ The microimmunofluorescence test is the test of choice

**Treatment, Prevention, and Control**

ᑏᑏ Doxycycline is the drug of choice

ᑏᑏ Controlled through improvements in living conditions and reduction of the lice population through use of insecticides

ᑏᑏ Inactivated vaccine is available for high risk populations

***EHRLICHIA AND ANAPLASMA***

**Trigger Words**

ᑏᑏ Intracellular bacteria, monocytic and granulocytic disease, ticks

**Biology and Virulence**

ᑏᑏ Small intracellular bacteria that stain poorly with Gram stain; best with Giemsa or Gimenez stains

ᑏᑏ Replicates in phagosome of infected cells

ᑏᑏ Intracellular growth protects bacteria from immune clearance

ᑏᑏ Able to prevent fusion of phagosome with lysosome of monocytes or granulocytes

ᑏᑏ Initiates inflammatory response that contributes to pathology

**Epidemiology**

ᑏᑏ Depending on the species of *Ehrlichia,* important reservoirs are white-tailed deer, white-footed mouse, chipmunks, voles, and canines

ᑏᑏ Ticks are important vectors, but transovarian transmission in inefficient

ᑏᑏ Disease in United States is most common in the southeastern, Mid-Atlantic, midwestern, and south central states

ᑏᑏ People at greatest risk are those exposed to ticks in the endemic areas

ᑏᑏ Disease is most common from April to October

**Diseases**

ᑏᑏ Diseases are human monocytic ehrlichiosis and human anaplasmosis (formerly called *human granulocytic ehrlichiosis*)

**Diagnosis**

ᑏᑏMicroscopy of limited value

ᑏᑏ Serology and nucleic acid amplification tests are methods of choice

**Treatment, Prevention, and Control**

ᑏᑏ Doxycycline is the drug of choice; rifampin is an acceptable alternative

ᑏᑏ Prevention involves avoidance of tick infested areas, use of protective clothing and insect repellents, and prompt removal of embedded ticks

ᑏᑏ Vaccines are not available

***COXIELLA BURNETII***

**Trigger Words**

Intracellular bacteria, flulike illness, subacute endocarditis, inhalation exposure, phase I and II antigens

**Biology and Virulence**

ᑏᑏ Small intracellular bacteria that stain poorly with Gram stain; best with Giemsa or Gimenez stains

ᑏᑏ Replicate in phagosomes of infected cells

ᑏᑏ Exists in two forms: small cell variant infectious, extremely stable to environmental factors; large cell variant is the metabolically active form

ᑏᑏ Phase transition occurs during infection: phase I with intact LPS, phase II with truncated LPS (O-antigen sugars missing)

ᑏᑏ Intracellular growth protects the bacteria from immune clearance

ᑏᑏ Able to replicate in acidic environment of phagosomes

ᑏᑏ Extracellular form extremely stable; can survive in nature for a prolonged period

**Epidemiology**

ᑏᑏ Many reservoirs, including mammals, birds, and ticks

ᑏᑏ Most human infections associated with contact with infected cattle, sheep, goats, dogs, and cats

ᑏᑏ Most disease acquired through inhalation; possible disease from consumption of contaminated milk; ticks are not an important vector for human disease

ᑏᑏ Worldwide distribution

ᑏᑏ No seasonal incidence

**Diseases**

ᑏᑏ Most infections are asymptomatic; most common acute presentation is nonspecific influenza-like syndrome; less than 5% develop significant acute disease (pneumonia, hepatitis, pericarditis, fever)

ᑏᑏ Endocarditis most common form of chronic disease

**Diagnosis**

ᑏᑏDetection of antibody response to phase Iand phase II antigens is test of choice

**Treatment, Prevention, and Control**

ᑏᑏ Doxycycline is the drug of choice for acute infections; hydroxychloroquine combined with doxycycline is used to treat chronic infections

ᑏᑏ Phase I antigen vaccines are protective and safe if administered in a single dose before the animal or human has been exposed to *Coxiella;* not available in the United States for animals or humans

**Organism Historical Derivation**

*Rickettsia rickettsii -*Named after Howard Ricketts, who implicated the wood tick as the vector of Rocky Mountain spotted fever

*R. akari akari, -* mite; the vector of rickettsia pox

*R. prowazekii -* Named after Stanislav von Prowazek, an early investigator of typhus who was a victim of this disease

*R. typhi - typhi,* typhus or fever

*Orientia tsutsugamushi - Orientia,* Orient; *tsutsugamushi,* “mite disease,” the popular name of this disease in the Orient

*Ehrlichia -* Named after the German microbiologist Paul Ehrlich

*E. chaffeensis -* First isolated in an Army reservist at Fort Chaffee, Arkansas

*E. ewingii -* Named after the American microbiologist William Ewing

*Anaplasma- an,* without; *plasma,* anything formed (a thing without form; referring to the intracytoplasmic inclusions)

*A. phagocytophilum - phago,* to eat; *kytos,* a vessel or enclosure; *philein,* to love (found in phagocytes)

*Coxiella burnetiid -* Named after Herald Cox and F.M. Burnet who isolated the bacterium from ticks in Montana and patients in Australia, respectively

**Epidemiology of Infections Caused by *Rickettsia* and Related Bacteria**

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**Human Diseases Caused by Rickettsia and Related Bacteria**

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***MYCOPLASMA PNEUMONIAE***

**Trigger Words**

No cell wall, person-to-person, tracheobronchitis

**Biology and Virulence**

ᑏᑏ The smallest free-living bacterium; able to pass through 0.45-μm pore filters

ᑏᑏ Absence of cell wall and a cell membrane containing sterols are unique among bacteria

ᑏᑏ Slow rate of growth (generation time, 6 hours); strict aerobe

ᑏᑏ P1 adhesin protein binds to base of cilia on epithelial cells, leading to eventual loss of ciliated epithelial cells

ᑏᑏ Stimulates migration of inflammatory cells and release of cytokines

**Epidemiology**

ᑏᑏ Worldwide disease with no seasonal incidence (in contrast to disease caused by most respiratory pathogens)

ᑏᑏ Primarily infects children between ages 5 and 15 years, but all populations susceptible to disease

ᑏᑏ Transmitted by inhalation of aerosolized droplet

**Diseases**

ᑏᑏ Strict human pathogen

 **Diagnosis**

ᑏᑏDiagnostic Tests for *Mycoplasma pneumoniae*

 Microscopy Test is not useful because organisms do not have a cell wall and do not stain with conventional reagents

 Culture Test is slow (2 to 6 weeks before positive diagnosis) and insensitive; it is not available in most laboratories

 Molecular diagnosis

 Polymerase chain reaction–based amplification assays, with excellent sensitivity; specificity is not well defined

**SEROLOGY**

Complement fixation Antibody titers versus glycolipid antigens peak in 4 weeks and persist for 6 to 12 months;poor sensitivity and specificity; rarely used

Today Enzyme immunoassays Multiple assays are available, with varying sensitivityand specificity; assays directed versus

P1 adhesin protein may be most specific Cold agglutinin Sensitivity and specificity poor, with crossreactions with other respiratory pathogens (e.g., Epstein-Barr virus, cytomegalovirus,

adenovirus); test commonly used but not recommended

**Treatment, Prevention, and Control**

ᑏᑏ Drug of choice is erythromycin, doxycycline, or newer fluoroquinolones

ᑏᑏ Immunity to reinfection is not lifelong, and vaccines have proved ineffective

**Important Mycoplasmataceae**

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***CHLAMYDIA TRACHOMATIS***

**Trigger Words**

Intracellular bacteria, elementary and reticulate bodies, trachoma, infant pneumonia, urethritis, LGV, person to

person

**Biology and Virulence**

ᑏᑏ Small gram-negative rods

ᑏᑏ Strict intracellular parasite of humans

ᑏᑏ Two distinct forms: infectious elementary bodies and noninfectious reticulate bodies

ᑏᑏ Lipopolysaccharide antigen shared by *Chlamydia* and *Chlamydophila* species

ᑏᑏ Major outer membrane proteins are species specific

ᑏᑏ Two biovars associated with human disease: trachoma and LGV

ᑏᑏ Infects nonciliated columnar, cuboidal, and transitional epithelial cells

ᑏᑏ Prevents fusion of phagosome with cellular lysosomes

**Epidemiology**

ᑏᑏ Most common sexually transmitted bacteria in United States

ᑏᑏ Ocular trachoma primarily in North and sub-Saharan Africa, the Middle East, South Asia, South America

ᑏᑏ LGV highly prevalent in Africa, Asia, and South America

**Diseases**

ᑏᑏ Pathologic effects of trachoma caused by repeated infections

**Diagnosis**

ᑏᑏ Culture is highly specific but relatively insensitive

ᑏᑏ Antigen tests (direct fluorescent antibody, enzyme-linked immunosorbent assay) are relatively insensitive

ᑏᑏ Molecular amplification tests are the most sensitive and specific tests currently available

**Treatment, Prevention, and Control**

ᑏᑏ Treat LGV with doxycycline or erythromycin

ᑏᑏ Treat ocular or genital infections with azithromycin or doxycycline

ᑏᑏ Treat newborn conjunctivitis or pneumonia with erythromycin

ᑏᑏ Safe sex practices and prompt treatment of patient and sexual partners help control infections

**Organism and Historical Derivation**

*Chlamydia - chlamydis,* a cloak

*C. trachomatis - trachomatis,* of trachoma or rough (the disease trachoma is characterized by rough granulations on the conjunctival surfaces that lead to chronic inflammation and blindness)

*C. pneumoniae - pneumoniae,* pneumonia

*C. psittaci - psittacus,* a parrot (disease associated with birds)

**Differentiation of *Chlamydia* That Cause Human Disease**

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***Chlamydia pneumoniae***

**Respiratory infections:** can range from asymptomatic or mild disease to severe atypical pneumonia requiring hospitalization

**Atherosclerosis:** *C. pneumoniae* has been associated with inflammatory plaques in blood vessels; the etiologic role in this

disease is controversial

***Chlamydia psittaci***

**Respiratory infections:** can range from asymptomatic colonization to severe bronchopneumonia with localized infiltration of

inflammatory cells, necrosis, and hemorrhage

Clinical Spectrum of *Chlamydia trachomatis* Infections

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***Chlamydia trachomatis***

**Trachoma:** chronic inflammatory granulomatous process of eye surface, leading to corneal ulceration, scarring, pannus formation, and blindness

**Adult inclusion conjunctivitis:** acute process with mucopurulent discharge, dermatitis, corneal infiltrates, and corneal vascularization in chronic disease

**Neonatal conjunctivitis:** acute process characterized by a mucopurulent discharge

**Infant pneumonia:** after a 2- to 3-week incubation period, the infant develops rhinitis, followed by bronchitis with a characteristic dry cough

**Urogenital infections:** acute process involving the genitourinary tract with characteristic mucopurulent discharge; asymptomatic infections common in women

**Lymphogranuloma venereum:** a painless ulcer develops at the site of infection that spontaneously heals, followed by inflammation and swelling of lymph nodes draining the area, then progression to systemic symptoms

**Time course of *Chlamydia psittaci* infection.**

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