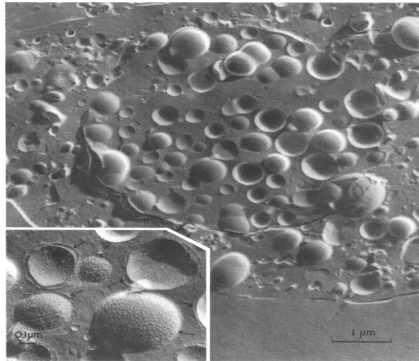


Chlamydia

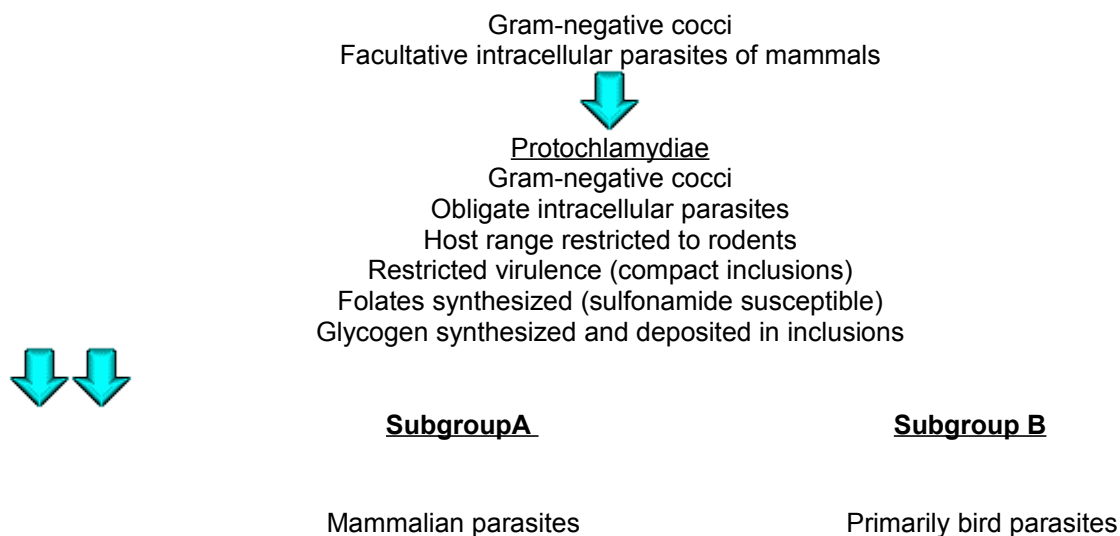


General Characteristics

The chlamydia, which are incorrectly called the PLT viruses or Bedsonia or basophilic viruses, are bacteria which are obligate intracellular parasites of higher animals (mammals and birds). The members of this group share a unique development cycle, a common morphology and a common family antigen. They are not transmitted by arthropods. These organisms are termed basophilic because they take up the Giemsa stain (i.e., they stain blue). They are gram-negative, non-motile and multiply in the cytoplasm of the host cell. These organisms generally parasitize epithelial cells. The methods used to study them are, in the main, those of the virologist rather than the bacteriologist. Furthermore, the clinical features, pathogenesis, pathology and epidemiology of chlamydial infections are similar to those of viral infections.

Taxonomy

The chlamydia fall into two main ecological groups. In the first group, are the agents causing trachoma, inclusion conjunctivitis, and lymphogranuloma venereum, which seem to infect man only. In the second group, are those agents transmitted to man as zoonotic infections. About 100 species of birds are naturally infected with chlamydia. This includes 71 species of parrots as well as finches, pigeons, chickens, ducks, turkeys and seabirds. The chlamydia are thought to have evolved in the following way:



Compact inclusions	Diffuse inclusions
Glycogen synthesized	Glycogen not synthesized
Folates synthesized	Folates not synthesized
Sensitive to D-cycloserine	Resistant to D-cycloserine
Restricted host range	Broadening of host range



Chlamydia trachomatis

Seven strains which are probably distinct species

Chlamydia psittaci

Ten strains which are probably distinct species

Chlamydia pneumoniae

Only one serotype has been identified

Morphology and Structure

The chlamydial cell is roughly spherical and measures between 0.3 and 1.0 μ in diameter, according to the stage of development. Both the small and the large cell types contain complete cell walls which are similar to the cell walls of gram-negative bacteria.

Under the cell wall lies a separate cytoplasmic membrane made up of large amounts of lipid. The DNA occurs as an irregular mass in the cytoplasm. There is no nuclear membrane. Ribosomes can be seen throughout the cytoplasm. The cells contain no capsule or flagella.

Metabolism

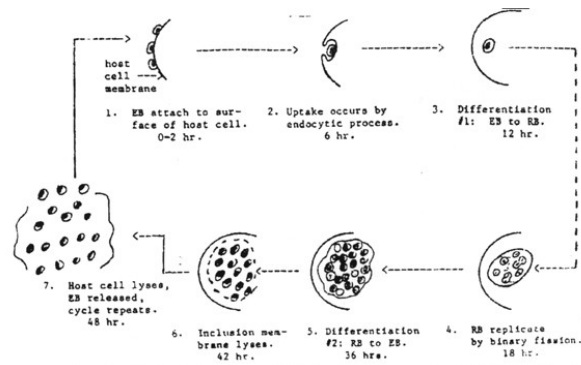
There are no detectable flavoproteins or cytochromes. It appears that the basis of the obligate intracellular parasitism is due to a lack of ATP-generating ability and the need to obtain ATP from the host cell. The cells can synthesize DNA, RNA and protein.

Growth and multiplication

Chlamydia pass through a series of developmental forms while multiplying by binary fission. This is termed the "developmental cycle." Two morphologically different developmental forms with a continuous gradation of intermediates between them can be recognized. One is a small cell about 0.3 μ in diameter, with an electron-dense nucleoid. The other is a large cell, 0.5 to 1.0 μ in diameter without a dense center.

There appears to be no significant difference in morphology or developmental cycle among the various chlamydia, and a single generalized description applies to all. The development cycle may be regarded as an orderly alternation of the small and large cell type. It is initiated by the highly infectious small cell which is taken into the host cell by phagocytosis. The engulfed small cell retains its morphological integrity in vacuoles bound by membrane derived from the surface of the host cell, and there is no eclipse (period in which the parasite loses the infectious ability). Instead, without loss of individuality, the small cell is reorganized into a large cell which is the vegetative multiplying form of these organisms. Then, still within the membrane-bound vacuole, the large cell grows in size and multiplies by repeated binary fission. The developmental cycle is completed by the reorganization of most of the large cells into small ones which are then available for infection of new host cells. The

time required for completion of a cycle varies from 24-48 hours, depending on the particular host/parasite system involved.



Characteristics of the elementary and reticulate bodies of Chlamydia can be found in the table below.

ELEMENTARY BODY (EB)	RETICULATE BODY (RB)
Size 0.3 um	Size 0.5 - 1.0 um
RNA:DNA content = 1.1	RNA:DNA content = 3.1
Infectious	Not infectious
Adapted for extracellular survival	Adapted for intracellular growth
Hemagglutinin present	Hemagglutinin absent
Induces endocytosis	Does not induce endocytosis
Metabolically inactive	Metabolically active

Pathogenicity

Subgroup A organisms primarily infect the mucous membranes of the eye or the genitourinary tract of humans. Subgroup B organisms, although primarily parasites of birds, can be transmitted to man where they cause a lung infection.

The mechanism by which chlamydia cause disease or injure cells is unknown. Chlamydial infections of mucous membranes cause damage to tissues deep in the epithelial layer; for example, in trachoma, scarring of the tarsal plate occurs frequently. There is some evidence that a toxin is produced.

Laboratory Diagnosis

Laboratory diagnosis is made by one or more of the following:

1. Isolation of the organism from infected tissue. The tissue is inoculated into the yolk sac of seven-day chick embryos or in McCoy human cells.
2. Characteristic cytoplasmic inclusion bodies infected cells.
3. Serological diagnosis:
 - a. Microimmunofluorescent tests in tears of patients with eye infections for the presence of anti-chlamydia antibody. In neonatal conjunctivitis and early trachoma, direct immunofluorescence of conjunctive cells with fluorescein - conjugated monoclonal antibody is sensitive and specific.

b. Delayed-type skin reaction (type IV hypersensitivity) to killed organisms in genitourinary infections (Frei test).

c. Rising titer of antibody against the chlamydial family antigen in lung infections. This accomplished with the complement fixation test or the fluorescent antibody test.

Treatment

Chlamydia exhibit low pathogenicity except in a compromised host. The chlamydial diseases are relatively easy to treat, but present two problems.

1. Latency of infection--infections may remain latent or sub-clinical for years.
2. Susceptibility of compromised host to reinfection--the compromised host usually remains compromised because of genetic and/or environmental factors and becomes reinfected.
3. Minimal symptomology

Chlamydia trachomatis - doxycycline or azithromycin

Chlamydia pneumonia - doxycycline or azithromycin or erythromycin

Chlamydia psittaci - doxycycline or erythromycin

Diseases

The chlamydial diseases include:

DISEASE	CAUSUAL AGENT	HOST
Subgroup A (person-to-person transmission)		
Trachoma	<i>Chlamydia trachomatis</i>	Man
Inclusion conjunctivitis	<i>Chlamydia trachomatis</i>	Fowl, Man
Urethritis	<i>Chlamydia trachomatis</i>	Man
Cervicitis	<i>Chlamydia trachomatis</i>	Man
Ophthalmia neonatorum	<i>Chlamydia trachomatis</i>	Man
Myocarditis	<i>Chlamydia trachomatis</i>	Man
Lymphogranuloma venereum	<i>Chlamydia trachomatis</i>	Man
Atherosclerosis	<i>Chlamydia trachomatis</i>	Man
Neonatal Pneumonia	<i>Chlamydia trachomatis</i>	Man
Subgroup B (mostly bird-to-human transmission)		
Bronchitis/pneumonia/sinusitis	<i>Chlamydia pneumoniae</i>	Man
Atherosclerosis	<i>Chlamydia pneumoniae</i>	Man
Meningopneumonitis	<i>Chlamydia psittaci</i>	Birds --> Man
Hepatic and renal dysfunction	<i>Chlamydia psittaci</i>	Birds --> Man
Conjunctivitis	<i>Chlamydia psittaci</i>	Birds --> Man
Abortion	<i>Chlamydia psittaci</i>	Birds --> Man
Endocarditis	<i>Chlamydia psittaci</i>	Birds --> Man

Chlamydia has on its surface, a peptide that resembles one in heart myosin. The peptide, when displayed by antigen-presenting cells, can trigger T-cells that attack both *Chlamydia* and heart cells, thus causing heart muscle inflammation (myocarditis). This autoimmune reaction also plays a role in the formation of the artery-clogging plaques of atherosclerosis.

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