Chlamydia

■ Chlamydiae are obligate cell parasites. They go through two stages in their reproductive cycle: the elementary bodies (EB) are optimized to survive outside of host cells. In the form of the initial bodies (IB), the chlamydiae reproduce inside the host cells. The three human pathogen species of chlamydiae are *C. psittaci*, *C. trachomatis*, and *C. pneumoniae*. Tetracyclines and macrolides are suitable for treatment of all chlamydial infections.

C. psittaci is the cause of **psittacosis** or **ornithosis**. This zoonosis is a systemic disease of birds. The pathogens enter human lungs when dust containing chlamydiae is inhaled. After an incubation period of one to three weeks, pneumonia develops that often shows an atypical clinical course.

C. trachomatis is found only in humans. This species causes the following diseases: 1. **Trachoma**, a chronic follicular keratoconjunctivitis. The pathogens are transmitted by smear infection. 2. **Inclusion conjunctivitis** in newborn children and **swimming-pool conjunctivitis**. 3. **Nonspecific urogenital infections** in both men and women (urethritis, cervicitis, salpingitis, etc.). 4. **Lymphogranuloma venereum**, a venereal disease observed mainly in countries with warm climates.

C. pneumoniae is responsible for infections of the upper respiratory tract as well as for a mild form of **pneumonia**. There is current discussion in the literature concerning a possible role of *C. pneumoniae* in the pathogenesis of atherosclerotic cardiovascular disease. ■

Overview and General Characteristics of Chlamydiae

Definition and classification. The bacteria in the taxonomic family *Chlamydiaceae* are small (0.3–1 µm) obligate cell parasites with a Gram-negative cell wall. The reproductive cycle of the chlamydiae comprises two developmental stages: The elementary bodies are optimally adapted to survival outside of host cells. The initial bodies, also known as reticulate bodies, are the form in which the chlamydiae reproduce inside the host cells by means of transverse fission. Three human pathogen species of chlamydiae are known: *C. psittaci*, *C. trachomatis* (with the biovars *trachoma* and *lymphogranuloma venereum*), and *C. pneumoniae*.

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- **Elementary bodies.** The round to oval, optically dense elementary bodies have a diameter of approximately 300 nm. They represent the infectious form of the pathogen and are specialized for the demands of existence outside the host cells. Once the elementary bodies have attached themselves to specific host cell receptors, they invade the cells by means of endocytosis (Fig. 4.**27**). Inside the cell, they are enclosed in an endocytotic membrane vesicle or inclusion, in which they transform themselves into the other form—initial bodies—within a matter of hours.

- **Initial bodies**. Chlamydiae in this spherical to oval form are also known as reticular bodies. They have a diameter of approximately 1000 nm. The initial bodies reproduce by means of transverse fission and are not infectious while in this stage. At the end of the cycle, the initial bodies are transformed back into elementary bodies. The cell breaks open and releases the elementary bodies to continue the cycle by attaching themselves to new host cells.

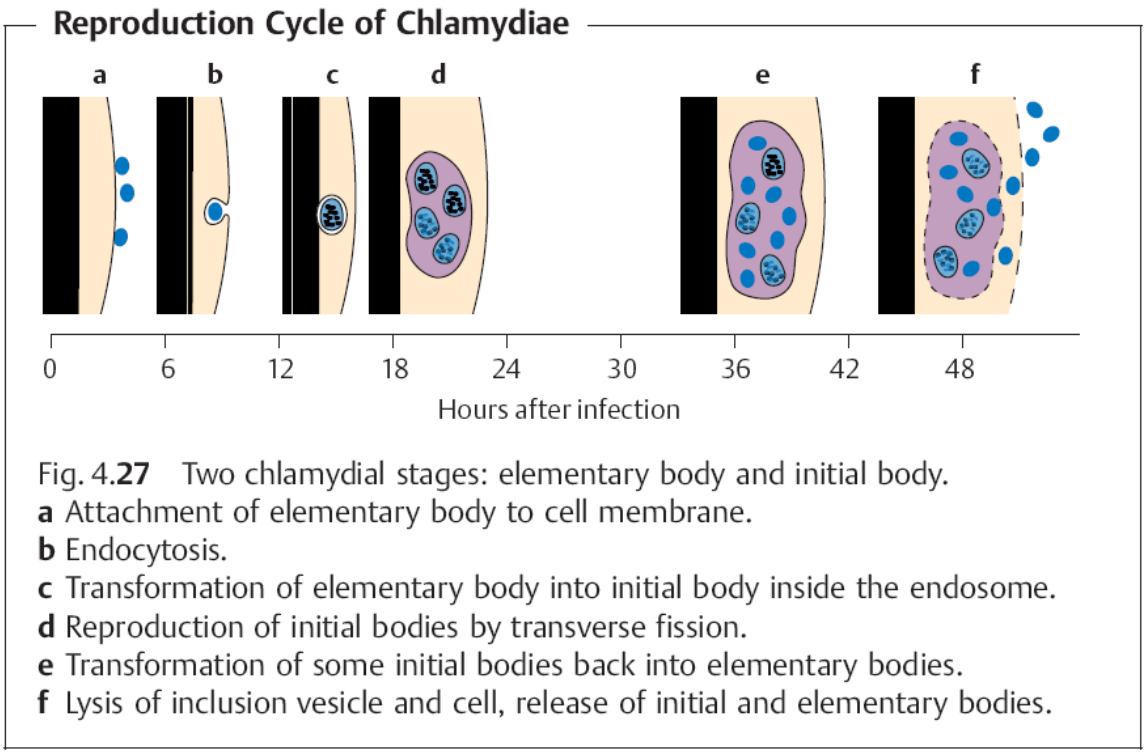

Fig. 4.**27** Two chlamydial stages: elementary body and initial body.
a Attachment of elementary body to cell membrane.
b Endocytosis.
c Transformation of elementary body into initial body inside the endosome.
d Reproduction of initial bodies by transverse fission.
e Transformation of some initial bodies back into elementary bodies.
f Lysis of inclusion vesicle and cell, release of initial and elementary bodies.

Culture. Chlamydiae exploit energy metabolism processes in their host cells that they themselves are lacking (ATP synthesis). For this reason, they can only be grown in special cell cultures, in the yolk sacs of embryonated hen eggs, or in experimental animals.

Chlamydia trachomatis (Trachoma, Lymphogranuloma venereum)

C. trachomatis is a pathogen that infects only humans. Table 4.**16** lists the relevant diseases, biovars, and serovars.

Trachoma is a follicular keratoconjunctivitis. The disease occurs in all climatic zones, although it is more frequent in warmer, less-developed countries. It is estimated that 400 million people carry this chronic infection and that it has caused blindness in six million. The pathogen is transmitted by direct contact and indirectly via objects in daily use. Left untreated, the initially acute inflammation can develop a chronic course lasting months or years and leading to formation of a corneal scar, which can then cause blindness. The **laboratory diagnostics** procedure involves detection of *C. trachomatis* in conjunctival smears using direct immunofluorescence microscopy. The fluorochrome-marked monoclonal antibodies are directed against the MOMP (major outer membrane protein) of *C. trachomatis*. The pathogen can also

Table 4.**16** Human Infections Caused by *Chlamydia trachomatis*

Disease/syndrome	Biovar	Most frequent serovars *
Trachoma	*trachoma*	A, B, Ba, C
Inclusion conjunctivitis	*trachoma*	D, Da, E, F, G, H, I, Ia, J, K
Urethritis, cervicitis, salpingitis (pharyngitis, otitis media)	*trachoma*	B, C, D, E, F, G, H, I, K, L_3
Lymphogranuloma venereum (syn. lymphogranuloma inguinale, lymphopathia venerea, Favre-Durand-Nicolas disease)	*lymphogranuloma venereum*	L_1, L_2, L_2a, L_3

* Determined with microimmunofluorescence.

Chlamydia pneumoniae

This new chlamydial species (formerly TWAR chlamydiae) causes infections of the respiratory organs in humans that usually run a mild course: influenza-like infections, sinusitis, pharyngitis, bronchitis, pneumonias (atypical). Clinically silent infections are frequent. *C. pneumoniae* is pathogenic in humans only. The pathogen is transmitted by aerosol droplets. These infections are probably among the most frequent human chlamydial infections. Serological studies have demonstrated antibodies to *C. pneumoniae* in 60% of adults. Specific laboratory diagnosis is difficult. Special laboratories can grow and identify the pathogen in cultures and detect it under the microscope using marked antibodies to the LPS (although this test is positive for all chlamydial infections). *C. pneumoniae*-specific antibodies can be identified with the microimmunofluorescence method. In a primary infection, a measurable titer does not develop for some weeks and is also quite low. The antibiotics of choice are tetracyclines or macrolides. There is a growing body of evidence supporting a causal contribution by *C. pneumoniae* to atherosclerotic plaque in the coronary arteries, and thus to the pathogenesis of coronary heart disease.