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Chlamydial Infection in Urologic Diseases

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1. Introduction

Chlamydiae are small gram-negative obligate intracellular microorganisms that preferentially infect squamocolumnar epithelial cells. *Chlamydia* species which can cause infections in humans are *C. pneumoniae, C. psittaci* and *C. trachomatis*. Of the three species, *C. trachomatis* is responsible for sexually transmitted diseases (STDs) in men and women. Identified in 1907, *C. trachomatis* was the first chlamydial agent discovered in humans. The life cycle of *C. trachomatis* consists of an extracellular form (the elementary body) and the intracellular form (the reticulate body). The elementary body attaches to and penetrates columnar epithelial cells, where it transforms into the reticulate body, the active reproductive form of the organism. The reticulate body forms large inclusions within cells and then begins to reorganize into small elementary bodies. *C. trachomatis* can be differentiated into 18 serovars (serologically variant strains) based on monoclonal antibody–based typing assays. Serovars A, B, Ba, and C are associated with trachoma (a serious eye disease that can lead to blindness), serovars D-K are associated with genital tract infections, and L1-L3 are associated with lymphogranuloma venereum.

The pathophysiologic mechanisms of *chlamydiae* are poorly understood. The initial response to infected epithelial cells is a neutrophilic infiltration followed by lymphocytes, macrophages, plasma cells, and eosinophilic invasion. The release of cytokines and interferons by the infected epithelial cell initializes this inflammatory cascade. Infection with chlamydial organisms invokes a humoral cell response, resulting in secretory immunoglobulin A (IgA) and circulatory immunoglobulin M (IgM) and immunoglobulin G (IgG) antibodies and a cellular immune response.

C. trachomatis infections are prevalent worldwide, but current research, screening, and treatment are focused on females, with the burden of disease and infertility sequel considered to be a predominantly female problem. *C. trachomatis* is responsible for a wide spectrum of diseases that include vaginitis, cervicitis, salpingitis, endometritis, conjunctivitis, and neonatal pneumonia. A role for this pathogen in the development of male urethritis, epididymitis, and orchitis is widely accepted. Also, *C. trachomatis* can cause chronic prostatitis and infertility.

This chapter covers *C. trachomatis* infection in urologic diseases focusing on male problems such as urethritis, epididymitis and orchitis; chronic prostatitis and infertility in terms of the epidemiology, screening, clinical manifestations, diagnosis, treatment and complication.

2. Epidemiology of *C. trachomatis*

In contrast to gonorrhea infection, most men and women who are infected are asymptomatic, and, therefore, diagnosis is delayed until a positive screening result or upon discovering a symptomatic partner. *Chlamydia* has been isolated in approximately 40-60% of males presenting with nongonococcal urethritis. Recent epidemiological studies indicate a high prevalence rate of asymptomatic men who act as a reservoir for chlamydial infections.

Chlamydia is the most common bacterial sexually transmitted infection in the world, causing an estimated 89 million new cases of infection each year (World Health Organization [WHO], 2001). Ethnic group or socioeconomic deprivation, introducing a screening program that is less available and accessible, and less acceptable to people from vulnerable and disadvantaged groups, could create or widen existing inequalities in *chlamydia* prevalence. According to the Centers for Disease Control and Prevention, the last 5 years have seen an increasing rate of infection (43.5%) and it is more common in women than in men (3:1) in USA (Centers for Disease Control and Prevention [CDC], 2010).

According to Low and colleagues (Low et al., 2007), in UK in 2004, 104,155 cases of *chlamydia* were diagnosed in genitourinary medicine clinics. The number of diagnosed infections has been increasing steadily since 1995, partly owing to increased numbers of people being tested; nearly 700,000 genital infections and sexually transmitted infections were diagnosed in genitourinary clinics in 2003 compared with 442,000 in 1995. In 2007, National Chlamydia Screening Programme was conducted with 4731 men and women aged 16–39 years participated in the cross-sectional screening survey in UK. There were 219 people with positive *chlamydia* results. Prevalence in 16–24-year-olds was 6.2% in women and 5.3% in men. The prevalence in young men was the same as in young women. The examination of risk factors for *chlamydia* in the prevalence and case–control studies did not find any factors, other than young age. The number of new partners in the past 12 months was the strongest predictor of infection.

Population based studies in Europe and the USA suggest that the prevalence of *chlamydia* in men and women aged 15–24 years is 2–6% (Andersen et al., 2002; Fenton et al., 2001; Miller et al., 2004; van Bergen et al., 2005). The peak age group for infection is 16–19 years in women and 20–24 years in men (CDC, 2010).

3. Screening

Asymptomatic chlamydial infection is common among both men and women, and detection often relies on screening. Routine laboratory screening for common STDs is indicated for sexually active adolescents. The CDC and the US Preventive Services Task Force each recommend annual chlamydial screening for all sexually active women ≤ 25 years of age and also for older women with risk factors (e.g., those who have a new sex partner or multiple sex partners). For the persons in correctional facilities, universal screening of adolescent females for *chlamydia* should be conducted at intake in juvenile detention or jail facilities. Universal screening of adult females should be conducted at intake among adult females up to 35 years of age or on the basis of local institutional prevalence data (CDC, 2010).

The benefits of screening could be demonstrated in areas where the prevalence of infection and rates of pelvic inflammatory diseases are decreasing since the screening programs began (Kamwendo et al., 1996; Scholes et al., 1996; Mertz et al., 1997; CDC, 2010). Evidence is insufficient to recommend routine screening for *C. trachomatis* in sexually active young men based on feasibility, efficacy, and cost-effectiveness. However, screening of sexually active young men should be considered in clinical settings associated with high prevalence of *chlamydia* (e.g., adolescent clinics, correctional facilities, and STD clinics) (CDC, 2010).

4. Clinical manifestation of chlamydial urethritis, epididymitis, prostatitis

C. trachomatis is a bacterium whose sexually transmitted strains D–K cause genital tract infections in women (cervicitis and urethritis) and men (urethritis, epididymitis, prostatitis). However, *chlamydia* is known as a 'silent' disease because about three-quarters of infected women and about half of infected men have no symptoms (van de Laar & Morre, 2007). Symptoms of chlamydial urethritis, if present, include discharge of mucopurulent or purulent material, dysuria, urethral pruritis, urinary frequency or urgency, and show up about 1-3 weeks after being infected. One of the most common symptoms for in cases of *chlamydia* in men is a painful urination.

In the worst cases *chlamydia* infection can, without treatment, lead on to other problems such as epididymitis or orchitis if the infection has made it to the epididymis or the testicles. This is particularly worrisome because it can occasionally cause a man to become sterile. In men younger than the age of 35 who are sexually active with women, the most common offending organisms causing epididymitis are *N. gonorrhoeae* and *C. trachomatis*. Approximately 45–85% of men with epididymitis have had prior *C. trachomatis* infections and/or gonococcal infections (Berger et al., 1978; Berger et al, 1979; Melekos & Asbach, 1988). Acute epididymitis represents sudden occurrence of pain and swelling of the epididymis associated with acute inflammation of the epididymis. Physical examination localizes the tenderness to the epididymis (although in many cases the testis is also involved in the inflammatory process and subsequent pain—referred to as epididymo-orchitis). The spermatic cord is usually tender and swollen. Early on in the process, only the tail of the epididymis is tender, but the inflammation quickly spreads to the rest of the epididymis and if it continues to the testis, the swollen epididymis becomes indistinguishable from the testis. Although the process is usually unilateral, it is sometimes bilateral. Physical examination may reveal a toxic and febrile patient. The skin of the involved hemiscrotum is erythematous and edematous, and the testis is quite tender to palpation or can be associated with a transilluminating hydrocele. If the diagnosis is not evident from the history, physical examination, and these simple tests, scrotal ultrasonography should be performed (to rule out malignancy in patients with chronic orchitis/orchialgia). The most important differential diagnosis in young men and boys is testicular torsion. Testicular torsion is often difficult to differentiate from an acute inflammatory condition. Scrotal ultrasound (with use of Doppler imaging to determine testicular blood flow) is especially helpful in differential diagnosis, but occasionally it will miss the diagnosis (particularly with intermittent or partial torsion) and the clinician should err in favor of the surgically correctable diagnosis of torsion.

Another potential problem without treatment of the *chlamydia* infection is chronic prostatitis. The evidence supporting the role of *C. trachomatis* in chronic prostatitis is conflicting. The predominant symptom of chronic prostatitis is pain, which is most commonly localized to the perineum, suprapubic area, and penis but can also occur in the testes, groin, or low back. Pain during or after ejaculation is one of the most prominent, important, and bothersome feature in many patients. Irritative and obstructive voiding symptoms including urgency, frequency, hesitancy, and poor interrupted flow are associated. Infertility and chronic prostatitis will be discussed in the '7. Complications'.

The *C. trachomatis* strains L1, L2 and L3 cause lymphogranuloma venereum. This tropical sexually transmitted infection is currently responsible for outbreaks of ulcerative proctitis mainly affecting homosexual men (many with HIV infection) in various European countries and the USA (Blank et al., 2005; Nieuwenhuis et al., 2004; Nieuwenhuis et al., 2003).

5. Diagnosis

Detection of current *chlamydia* infection is based on demonstration of the organism. Tissue culture methods, direct fluorescent antibody tests or enzyme-linked immunosorbent assays (EIA) have now been largely replaced by nucleic acid amplification tests (NAATs). Culture and hybridization tests require urethral swab specimens, whereas NAATs can be performed on urine specimens. The sensitivity and specificity of the NAATs are clearly the highest of any of the test platforms for the diagnosis of chlamydial infections. Since accurate diagnosis is the goal, there is no justification for the ongoing use of other technologies. Non-culture tests such as EIA and DNA probe assays are inferior to NAATs with respect to performance. According to the Expert Consultation Meeting Summary Report 2009, NAATs are recommended for detection of reproductive tract infections caused by *C. trachomatis* in men and women with and without symptoms.

Optimal specimen types for NAATs are first catch urine from men and vaginal swabs from women. There is little need for urethral swab specimens and in some studies these samples are less sensitive than urine; urethral swab specimens and male urine were equivalent in specificity. For female screening, vaginal swab specimens are the preferred specimen type. Vaginal swab specimens are as sensitive as cervical swab specimens and there is no difference in specificity. Cervical samples are acceptable when pelvic examinations are done, but vaginal swab specimens are an appropriate sample type even when a full pelvic exam is being performed. Cervical sample specimens are certainly acceptable for NAAT testing in those settings that combine Pap and sexually transmitted infection testing from the same sample, such as liquid cytology. There was some concern about some liquid cytology samples being more likely to result in inhibition of amplification or contamination in some assays, as well as, a concern that liquid cytology samples lead to testing of populations at low risk for infection. Female urine, while acceptable, may have reduced performance when compared to genital swab samples. NAATs are also recommended for the detection of rectal and oropharyngeal infections caused by *C. trachomatis*. However, these specimen types have not been cleared by the FDA for use with NAATs and laboratories must establish performance specifications to satisfy CMS regulations for CLIA compliance prior to reporting results for patient management. Ninety five percent of testing for *chlamydia* performed using a test of choice or acceptable test (Table 1).

Test	Sites FCU	Cervix	Urethra	Pharynx	Rectum	Vulvo-vaginal
NAAT	1	1	1	3	3	3
EIA	4	2	2	5	5	5
DFA	2	2	2	2	2	5
TC	5	2	2	1	1	5

FCU, First catch urine; NAAT, nucleic acid amplification test; EIA, enzyme immunoassay; DFA, direct fluorescent antibody; TC, tissue culture.
1, test of choice; 2, acceptable, but not first choice; 3, not licensed, although encouraging work being performed; 4, only for use in asymptomatic males; 5, not recommended.
All recommendations are at grade B unless stated otherwise.

Table 1. Summary of recommended tests for use with different sites of samples (Carder et al., 2006)

These tests are very accurate, but are laboratory dependent, creating a delay between testing and receipt of diagnosis, caused by the time it takes to transport the test sample to the laboratory and process the result. This delay is problematic, as a number of infected patients will not return for treatment, following their positive diagnosis. Point-of-care testing methods can provide results within hours after the tests are carried out, which could allow infected patients to be treated immediately, as well as allowing the immediate identification of recent sexual partners who should also be tested. The Chlamydia Rapid Test is a point-of-care test that has reported improved accuracy. However, according to the recent systematic review of the clinical effectiveness and cost-effectiveness of rapid point-of-care tests for the detection of genital *chlamydia* infection, NAATs was found to be less costly and more effective, although there were circumstances under which point-of-care testing could become a viable alternative (i.e. if uptake rates for testing were increased using this point-of-care method) (Hislop et al., 2010). There are currently no point-of-care assays on the market that are suitable for routine use, although some may be of use in high risk populations where immediate treatment is the overriding concern due to poor follow up. The group felt that development of improved point-of-care tests desirable.

Laboratory tests should include Gram stains of a urethral smear and a midstream urine specimen. A urethral swab and midstream urine specimen should be sent for culture and sensitivity testing. When a boy or young man is diagnosed with epididymitis or orchitis, and the diagnosis is uncertain, he should be further evaluated with duplex Doppler scrotal ultrasonography to rule out torsion.

To detect recent or past exposure to *C. trachomatis*, both systemic and local antibodies in secretions can be used. In order to be considered as a diagnostic test the specificity must be high. The microimmunofluorescence test is considered the gold standard but is difficult to perform and the specificity of the test has been questioned. Antibodies to the chlamydial lipopolysaccharide could cause cross-reactivity but specific antibodies to *C. pneumoniae* and *C. trachomatis* can usually be distinguished by the test. ELISA tests based on peptides from

the major outer-membrane protein polyantigen of *C. trachomatis* have so far showed high specificities. Although IgG antibodies can be detected in serum in 40-100% of infected women, demonstrated by cell culture or NAAT, 16-87% of *C. trachomatis*-negative women also have such antibodies. The situation is similar for serum IgA antibodies but at a lower level. The predictive values therefore become unacceptably low to use IgG or IgA antibodies in serum to diagnose current lower genital tract infection. The shorter half-life of IgA antibodies compared to IgG has suggested that IgA antibodies could reflect persistent infection. There is no solid ground as yet for the use of IgA antibodies as a marker of persistent or unresolved infection by *C. trachomatis.* IgM antibodies may have a better positive predictive value but the sensitivity is too low, which precludes their use for the diagnosis of genital chlamydial infection (Persson, 2002).

6. Treatment

Uncomplicated lower genital tract *chlamydia* infections can be cured by a single dose or short course of antibiotics. The guidelines for the treatment of persons who have or are at risk for STDs were updated by CDC after consultation with a group of professionals knowledgeable in the field of STDs who met in Atlanta on April 18–30, 2009. The approach to the management of uncomplicated genital chlamydial infection in adults includes (1) treatment of patients (to reduce complications and prevent transmission to sex partners), (2) treatment of sex partners (to prevent reinfection of the index patient and infection of other partners), (3) risk-reduction counseling, and (4) repeat chlamydial testing in women a few months after treatment (to identify recurrent/persistent infections). In the guidelines, the CDC convened an advisory group to examine recent abstracts and published literature addressing management of *C. trachomatis* infections in adolescents and adults. Key questions were posed and answered on the basis of quality of evidence and expert opinion. Clinical trials continue to demonstrate equivalent efficacy and tolerability of azithromycin and doxycycline regimens, and both remain recommended as first-line therapy in nonpregnant individuals. Azithromycin 1g and doxycycline 100mgs bd for 7 days have been shown to be >95% effective in the treatment of uncomplicated lower genital tract *C. trachomatis* infection (Horner, 2008; Horner & Boag, 2006). For those with upper genital tract disease i.e., pelvic inflammatory disease, a prolonged course of treatment for up to 14 days is recommended (Royal College of Obstetricians and Gynaecologists [RCOG], 2008). More data and clinical experience are available to support the efficacy, safety, and tolerability of azithromycin in pregnant women. Evidence is building that expedited partner therapy, with provision of treatment or a prescription, may be just as effective as or more effective than standard partner referral in ensuring partner treatment and preventing *chlamydia* recurrence in women. Although there are more studies needed and barriers to be addressed before its widespread use, expedited partner therapy will be recommended as an option for partner management.

Test of cure is not routinely recommended if standard treatment has been given, there is confirmation that the patient has adhered to therapy, and there is no risk of re-infection. However, if these criteria cannot be met or if the patient is pregnant a test of cure is advised. This should be taken using the same technique as was used for the initial testing. Ideally, a minimum of 3–5 weeks post-treatment is required as NAATs will demonstrate residual DNA/RNA even after successful treatment of the organism (recommendation grade A).

7. Complications

C. trachomatis can cause damage to both women and men's reproductive organs. If *chlamydia* is left untreated, men may develop chronic complications or irreversible damage which may cause male infertility. There is not thought to be any lasting immunity following a *chlamydia* infection that has resolved spontaneously or been treated with antibiotics, so repeated infections can occur (Holmes et al., 1999).

7.1 Chronic prostatitis

Prostatitis is the most common urologic diagnosis in men younger than 50 years and represents 8% of urology office visits (Collins et al., 1998). Chronic pelvic pain syndrome (CPPS) which is divided into two categories, inflammatory CPPS (Category ⅢA which corresponds to the former chronic nonbacterial prostatitis), and non-inflammatory CPPS (Category ⅢB which corresponds to the former prostatodynia), is the most common type of prostatitis. It is condition that many clinicians find difficult to treat effectively. The problem is that although in semen and expressed prostatic secretions there is evidence of inflammation, no pathogens are usually found in samples analyzed when routine culture methods are used. The clinical symptoms of patients with CPPS IIIA and IIIB are similar, perineal pain, often radiating to the genital area, urinary symptoms, ejaculatory disturbance, and are of chronic nature. The cause of CPPS has not yet been established and there is a lot of controversy regarding its etiology (Motrich et al., 2005). However, there is some substantial empirical support for a potential role of genitourinary tract infections in chronic prostatitis/CPPS as the etiology of this disease. Many patients relate the onset to sexual activity, often to an episode of urethritis (Krieger et al., 1999). Antimicrobials often provide transient or partial relief of symptoms and standard practice is to provide multiple courses of antimicrobials (Nickel et al., 1994; Nickel & Costerton, 1992). For many years attempts have been made to prove the role of certain microorganisms in the pathogenesis of CPPS. Attention has focused on *C. trachomatis,* the most frequent cause of non-gonococcal urethritis in sexually active men. It is believed that these bacteria can spread via intracanalicular ascension from the urethra. However, the evidence supporting the role of *C. trachomatis* as an etiologic agent in chronic prostatitis is conflicting. Mardh and Colleen (Mardh et al., 1972) found that one third of men with chronic prostatitis had antibodies to *C. trachomatis* compared with 3% of controls. Shortliffe and coworkers (Shortliffe et al., 1992) found that 20% of patients with nonbacterial prostatitis had antichlamydial antibody titers in the prostatic fluid. Bruce and colleagues (Bruce et al., 1981) found that 56% of patients with "subacute or chronic prostatitis" were infected with *C. trachomatis* (examining early morning urine, prostatic fluid, or semen). In a follow-up study, Bruce and Reid (Bruce & Reid, 1989) found that 6 of 55 men with abacterial prostatitis, including 31 believed to have chlamydial prostatitis, met strict criteria for positive diagnosis for chlamydial prostatitis based on identification of the organisms by culturing or immunofluorescence. *Chlamydia* has also been isolated in prostate tissue specimens. Poletti and coworkers (Poletti et al., 1985) isolated *C. trachomatis* from prostate samples obtained by transrectal aspiration biopsy of men with "nonacute abacterial prostatitis." Abdelatif and colleagues (Abdelatif et al., 1991) identified intracellular *chlamydia* employing "in-situ hybridization techniques" in transurethral

prostate chips from 30% of men with histologic evidence of "chronic abacterial prostatitis." Shurbaji and associates (Shurbaji et al., 1988) identified *C. trachomatis* in paraffin-embedded secretions in 31% of men with histologic evidence of prostatitis compared with none in patients with BPH without inflammation.

Although Mardh and Colleen (Mardh et al., 1972) suggested that *C. trachomatis* may be implicated in as many as one third of men with CP, their follow-up studies employing culturing and serologic tests could not confirm *C. trachomatis* as an etiologic agent in idiopathic prostatitis (Mardh & Colleen, 1975; Mardh et al., 1978). Shortliffe and Wehner (Shortliffe & Wehner, 1986) came to a similar conclusion when they evaluated antichlamydial antibody titers in prostatic fluid. Twelve percent of controls compared with 20% of patients with nonbacterial prostatitis had detectable antibodies. Berger and coworkers (Berger et al., 1989) could not culture *C. trachomatis* from the urethras in men with CP nor did they find a serologic or local immune response to *C. trachomatis* in such patients. Doble and associates (Doble et al., 1989) were not able to culture or detect by immunofluorescence *chlamydia* in transperineal biopsies of abnormal areas of the prostate in men with chronic abacterial prostatitis. Krieger and colleagues (Krieger et al., 1996) were only able to find *chlamydia* in 1% of prostate tissue biopsies in men with CP. A further localization and culture series by Krieger and associates (Krieger et al., 2000) also failed to culture *chlamydia* from either urethral or prostate specimens. Further elucidation of the role of chlamydial etiology of prostate infection is required to make any definitive statement on the association between isolation of this organism and its prostatic origin and effect (Weidner et al., 2002). In the follow-up of standardized prostatitis patients, a combination of urological tests in EPS and seminal plasma combined with genital chlamydial DNA material, may further elucidate the chlamydial aetiology of prostate infection.

7.2 Infertility

There are some studies of *C. trachomatis* in men and women undergoing investigations for infertility using modern screening methods. The major sequelae of *C. trachomatis* infection in women are tubal factor infertility and tubal ectopic pregnancy. Sequelae of *C. trachomatis* infection in men may include male factor infertility but why this occurs remains uncertain . There have been a number of studies on the relationship between *C. trachomatis* infection and sperm quality, with conflicting results. However, there have been major differences in study design with: significant variation in the methodology used to measuring the history of chlamydial infection (i.e. serology versus molecular methods); as well as variable and sometimes inadequate methods to assess semen quality. More recent studies (Hosseinzadeh et al., 2004; Bezold et al., 2007; Al-Mously et al., 2009), using molecular methods to detect infection, and robust methods of laboratory andrology to examine semen, have generally found that men with a current infection of *C. trachomatis* have poorer quality ejaculates compared than men who do not. It is unclear whether this is because of reduced levels of spermatogenesis in the presence of the bacterium, or whether infection causes an altered ejaculatory response. However, it has been observed that persistent infection can result in the scarring of ejaculatory ducts or loss of stereocilia (Gonzalez-Jimenez & Villanueva-Diaz, 2006). In addition to any changes in semen quality, there is growing evidence to suggest that

exposure to *C. trachomatis* can affect sperm function (Pacey & Eley, 2004; Eley et al., 2005a). In vitro experiments have shown that *C. trachomatis* triggers tyrosine phosphorylation of sperm proteins (Hosseinzadeh et al., 2000), induces premature sperm death (Hosseinzadeh et al., 2001) and stimulates an apoptosis-like response in sperm (Eley et al., 2005b; Satta et al., 2006), leading to increased levels of sperm DNA fragmentation (Gallegos et al., 2008; Satta et al., 2006). At least some of these effects are caused by lipopolysaccharides (Hosseinzadeh et al., 2003).

With regard to infertility patients receiving treatments such as IVF, the Royal College of Obstetricians and Gynaecologists recommended that women should be screened for *C. trachomatis*, or given appropriate antibiotic prophylaxis, before any uterine instrumentation takes place (RCOG, 2008). This was reiterated in the later NICE guidelines (UK Collaborative Group for HIV and STI Surveillance, 2005). However, Sowerby and Parsons (Sowerby & Parsons, 2004) noted that 53% of UK clinics either screen the female partner or give appropriate antibiotic prophylaxis. In the recruitment of sperm, egg and embryo donors the most recent UK guidelines produced by the Association of Biomedical Andrologists, Association of Clinical Embryologists, British Andrology Society, British Fertility Society and Royal College of Obstetricians and Gynaecologists (RCOG, 2008) recommend that all donors be screened for *C. trachomatis* prior to donation, and this is reiterated in the 8th Edition of the Human Fertilisation and Embryology Authority (HFEA) Code of Practice (HFEA Code of Practice, 2009).

Since it is known *C. trachomatis* can survive in liquid nitrogen (Sherman & Jordan, 1985) and that infection following insemination with cryopreserved donor semen is possible (Broder et al., 2007), the freezing and storage of gametes and embryos from patients with an active *C. trachomatis* infection is of obvious concern. This is not only to prevent women who receive treatment with thawed gametes and embryos from becoming infected with *C. trachomatis*, but because of the theoretical concern that the bacteria may cross-contaminate other (*C. trachomatis* negative) samples being stored in the same cryostorage vessel. To date, such cross contamination has only been shown with regard to Hepatitis B during storage of peripheral blood stem cells. (Tedder et al., 1995) and has never been demonstrated during reproductive tissue storage. However, the HFEA now require that all patients placing material in storage be screened for bloodborn viruses prior to placing material in storage (HFEA Code of Practice, 2009). For patients undergoing planned IVF treatment, a similar level of risk reduction will be achieved if both partners are screened and treated for *C. trachomatis*.

8. Conclusion

Population based studies in Europe and the USA suggest that the prevalence of *C. trachomatis* in men and women aged 15–24 years is 2–6%. The prevalence in young men was the same as in young women.The peak age group for infection is 16–19 years in women and 20–24 years in men. A role for *C. trachomatis* in the development of male urologic diseases such as urethritis, epididymitis, and orchitis is widely accepted. Also, *C. trachomatis* can cause chronic prostatitis and infertility. NAATs are recommended for detection of reproductive tract infections caused by *C. trachomatis* in men and women. Optimal specimen types for NAATs are first catch urine from men and vaginal swabs from women. Clinical

trials continue to demonstrate equivalent efficacy and tolerability of azithromycin and doxycycline regimens, and both remain recommended as first-line therapy. Ascending chlamydial infections have been thought to be an infective cause of prostatitis. Unfortunately, the definitive association between *C. trachomatis* and prostatitis is limited by various factors. Sequelae of *C. trachomatis* infection in men may include male factor infertility but why this remains uncertain.

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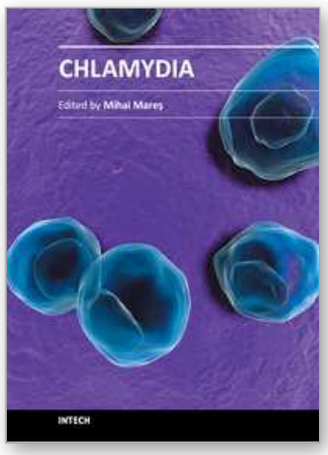
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Nowadays, Chlamydia still represents a redoubtable pathogen. Among its consequences, the blindness in children and severe impairment of reproductive health in adults are the most mutilating. Worldwide, it is estimated that six million of people suffer from post-trachoma blindness and almost 90 million become sexually infected each year. Due to its silent evolution and sexually transmission, the chlamydial infection can occur in anyone. The book “Chlamydia - A Multifaceted Pathogen” contains an updated review of all-important issues concerning the chlamydial infection. It comprises 18 chapters grouped in four major parts dealing with etiology and pathogenicity, clinical aspects, diagnosis and prevention. The new molecular data about the pathogenicity and the exhaustive presentation of clinical findings bring novelty to the book and improve our knowledge about Chlamydia induced diseases.

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