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Ophtalmia Neonatorum

Flora Abazi, Mirlinda Kubati, Blerim Berisha, Masar Gashi,
Dardan Koçinaj and Xhevdet Krasniqi
University Clinical Centre of Kosovo
Republic of Kosovo

1. Introduction

Sexually transmitted infections (STIs) or sexually transmitted diseases (STDs) are common in low- income countries. Among adult women STIs (excluding HIV) represent around 9% of the disease burden (World Bank, 1993). This group of disease (Table 1) can lead to infertility, abortion, neonatal blindness and sometimes death. Furthermore in up to 75% of women STIs are thought to be asymptomatic, knowing also that vaginal discharge might be caused by non-sexually transmitted changes in vaginal flora (Sloan et al., 2000; Lush et al., 2003).

Common STI syndrome	Possible cause
Genital ulcer disease	Chancroid, Syphilis, Chlamydia, Herpes simplex virus, Donovanosis
Urethral discharge	Gonorhoea, Chlamydia
Vaginal discharge	Gonorhoea, Chlamydia, Herpes, trichomonas, Candida, Bacterial vaginosis
Pelvic inflammatory disease	Gonorhoea, Chlamydia
Ophtalmia neonatorum	Gonorhoea, Chlamydia

Table 1. Common STI syndromes and possible causes Modified from Lush L, Walt G, Ogden J. (2003) Transferring policies for treating sexually transmitted infections: what's wrong with global guidelines? Health Policy and planning 18(1): 18-30.

Ophtalmia neonatorum (neonatal conjunctivitis) is an ocular redness, swelling and drainage (sometimes even purulent) due to a pathogenic organism or even chemical irritant occurring in infants less than 4 weeks of age with potentially serious ocular and systemic consequences (Merck Manual 2006, Rudolph's 2002). The frequency of this disease varies up to 19% and is related to prenatal care (Rudolph's 2002).

Bacterial infection is acquired from infected mother during delivery. The most common bacteria is Chlamydia trachomatis causing Chlamydial ophtalmia occurring in 2 to 4% of births. This entity accounts for about one third to half of all conjunctivitis in neonates, characterizing developed countries (Current, 2009), while the prevalence of maternal chlamidial infection ranges from 2 to 20% (Mohile et al., 2002) with the incidence increasing dramatically through years (Miller, 2006).

Streptococcus pneumoniae and Haemophilus influenze as other bacteria responsible account for another 15% of cases. On the other hand, the incidence of conjunctivitis due to Neisseria gonorrhoeae (gonorrheal ophtalmia) in the USA is 2 to 3 per 10,000 births.
Usually the isolation of other bacteria than mentioned above (e.g. Staphylococcus aureus) represents colonization.
Herpetic kerato- conjunctivitis caused by herpes simplex virus types 1 and 2 represents the major viral infection, while chemical conjunctivitis is generally secondary to the instillation of ocular drops (e.g. silver nitrate) for prophylaxis purpose.

2. Etiology

Ophtalmia neonatorum may be caused by microorganisms (infectious etiology), or may be sterile (non infectious etiology) from chemical irritants (Table 2). Sterile or non infection ophtalmia neonatorum usually is caused by silver nitrate during prophylaxis of this entity. As far as infectious etiology concerns there are different bacteria and viruses known to cause this disease. The most commonly isolated bacteria are: Chlamydia trachomatis and Neisseria gonorrhoeae; but also: Staphylococcus aureus, Streptococcus pneumoniae, Streptococcus viridians, Staphylococcus epidermidis, Escherichia coli, Klebsiella pneumoniae, Serratia marcescens, Proteus, Enterobacter, and Pseudomonas species. Also, Eikenella corrodens has been reported as a cause of neonatal conjunctivitis (Chhabra et al., 2008). The most commonly viral cause is Herpes simplex virus (HSV) associated most often with a generalized herpes simplex infection.

Etiology	Percentage (%)	Incubation period	Associated problems
Chemical	Varies	1	---
Chlamydia trachomatis	2-40	5-14	Pneumonia
Neisseria gonorrhoeae	<1	2-7	Disseminated infection
HSV	<1	6-14	Disseminated infection

Table 2. Pathogens of neonatal conjunctivitis

Modified from "Red Book-Report of the Committee on Infectious Diseases, 29th Edition. The American Academy of Pediatrics.".http://aapredbook.aappublications.org/.

2.1 Silver nitrate solution

Silver nitrate solution is one the most common sterile causes of ophtalmia neonatorum. It was used for prophylaxis of ocular gonococcal infections as the most effective agent in prevention of ophtalmia neonatorum by direct inactivating of Gonococi. Crede's method was a major advance in preventing of ophtalmia neonatorum using 2% drops of Silver nitrate (Jatla et al., 2009). Later silver nitrate was found to be toxic for conjunctiva, causing chemical neonatal conjunctivitis, usually lasting 2-4 days. Because of replacement of silver nitrate with neomycin and chloramphenicol eye drops, and erythromycin ointment the incidence of chemical neonatal ophtalmia in the most countries have significantly decreased.

2.2 Chlamydia trachomatis

It was postulated that unknown agent acquired from the genital tract of mother, is a cause of abacterial ophthalmia neonatorum (Kroner, 1884). Lindner comes to conclusion that inclusion of blennorrhoea was due to the trachoma agent, and after techniques evolution in Ophtalmology the first isolation was performed by Tang et al. This was realized by using the yolk sac of embryonated eggs and latter followed by isolating chlamydia from the babyes eyes with inclusion of blennorrhoea, and also from cervix of mother (Linder, 1909; T'ang et al., 1957; Jones et al., 1959).

Chlamydia trachomatis is an intracellular parasite, one of the common causes of ophtalmia neonatorum 2-4% of births. Chlamydia trachomatis, based on immunogenic epitope analysis of the major outer membrane protein (MOMP), differentiates in 18 serovars. D to K serovars are common urogenital and ocular pathogens. Genotype classification correlates with the serovar classification previously mentioned (Rodriguez et al., 1993). Even though this classification is practical and accepted among researchers, it is found increased frequency of C. trachomatis genotype E in neonatal conjunctivitis (Lucía et al., 2010).

It is thought that infants may acquire infection from their immediate surroundings, not only from mother birth canals. The high incidence of caesarean sections with high incidence of early onset conjunctivitis suggests in a possibility of intrauterine Chlamydial infection due to rupture of membrane. These kind of infections with Chlamydia trachomatis are sexually transmitted and WHO estimated 90 million new cases in 1999 (World Health Organisation, 2010). The developing risk of the Chlamydial infection as a conjunctivitis or pneumonia at birth is increased with an incidence up to 15% (Schachter et al., 1986; Numazaki et al., 2003; Rosenman et al., 2003).

In some newborns with Chlamydia conjunctivitis, the infection persists too long with panus and scarring formation and after this, if this infection is left untreated it may be complicated even with pneumonia. Prevalence of this conjunctivitis is 8%. (Hobson, 1977; Valencia et al., 2000; Olatunji, 2004).

Chlamydial conjunctivitis occurs after three days of life but may occur up to two weeks of life with mucopurulent and less inflamed discharge. Chlamydial conjunctivitis is associated with low risk of blindness compare to Gonorrheal conjunctivitis.

2.3 Neisseria gonorrhoeae

Neisseria gonorrhoeae was identified by Albert Neisser in 1879 in stained smears of exudates. Availability of Sulfonamides and Penicillin in 1943 was effective in treating of Gonorroheae (Kampmeier, 1978; Morton, 1977).

In the past N. Gonorroheae was a common cause of conjuctivitis, but after 1881 based on observations of Crede (using the silver nitrate) the prevalence as a causative agent of ophtalmia is decreased, in the industrial zones from 10 to 0.3% (Di Bartolomeo et al., 2001).

Neisseria species are aerobic, gram negative, non motile and non spore forming. Gonococci occurs in pairs as diplococcal and have outer membrane overlying, a thin peptidoglycan and cytoplasmic membrane. The species lacks a true polysaccharide capsule but produces a surface polyphosphate that provides a hydrophilic, negatively charged surface. The microbes frequently are seen within phagocytes in Gram stains of clinical specimens (Noegel et al., 1983).

Gonococci have ability to adhere to mucosal epithelial cells and thus can survive, activating nuclear factor kappa B and activator protein 1, with release of numerous of cytokines and chemokines (Nauman et al., 1997; Ramsey et al., 1995).
The individual gonococci can invade, replicate intracellulary, and by exocytosis can exit into the submucosal space (Alexey et al., 2000; Nauman et al., 1999). This lead in a chemotactic influx of neutrophils resulting in formation of micorabscesses and exudation of purulent material into lumen of infected tissues. Infection can persist for weeks to months if untreated because of escape immune response (Gergg et al., 1983; Casey et al., 1986; Shafer et al., 1986; Kallstrom et al., 1997).
Incubation period of Neisseria gonorrhoeae in eye infection is 2 to 5 days and in some cases may arise 2 to 3 weeks (Gutman, 2001). Gonococcal conjunctivitis begins as benign and bilateral with eyelid edema, followed by chemosis. The discharge in the beginning is sero-sanguineous, later becomes thick and purulent, and may contain also blood. The infection can spread if treatment is delayed causing complications such as corneal ulceration and perforation, iridocyclitis, and panophtalmitis. From conjunctiva gonococcus can spread to cause gonococcus septicemia, arthritis, and other manifestations (Friendly, 1969).
Staphylococcus aureus can cause ophtalmia neonatorum with purulent discharge. The treatment consists in topical or systemic antibiotic. In some cases spontaneous resolution can occur. Also, in Ophtalmia neonatorum are verified methicillin and erythromycin resistant S. aureus, but serious ophtalmologic infection was not found. In case of erythromycin-resistant Staphylococcus aureus conjunctivitis is used erythromycin ointment to prevent ophtalmia neonatorum (Cimolai, 2006; Hedberg et al., 1990).
The group B Streptococcus also may causes ophtalmia neonatorum, and is resolved after 7 days of treatment (Pöschl et al., 2002).
Eikenella corrodens is a gram-negative bacillus, fastidious, slow growing, and facultative anaerobic bacterium. It is found as the normal flora of the human mouth, nasopharynx, gut, and genitourinary tract. In the last two decades has been recognized as cause of head and neck infections. It is presented as a cause of neonatal conjunctivitis (Chhabra et al., 2008).
Neonatal conjunctivitis also is caused from other bacteria such as: Staphylococcus epidermidis, Streptococcus pneumoniae, Haemophilus species, Klebsiella pneumoniae, Pseudomonas aeruginosa, and Escherichia coli (Martinez et al., 1993; Olatunji et al., 2007).

2.4 Herpes simplex virus

Herpes simplex virus (HSV) can lead to neonatal keratoconjuctivitis passing to the baby during childbirth. Although it is rare it might be associated with a generalized herpes simplex infection (Overall, 1994).

2.5 Risk factors of neonatal conjuctivitis

Risk factors of neonatal conjunctivitis may include:

- Maternal infections
- Exposure of the infant to infectious organisms
- Increased birth weight
- Inadequacy of ocular prophylaxis immediately after birth (Gichuhi et al., 2009)
- Premature Rupture Of Membranes (Wu et al., 2009)

- Ocular trauma during delivery
- Mechanical ventilation
- Prematurity
- Poor prenatal care
- Poor hygienic delivery conditions
- Post-delivery infection due to direct contact with health care workers or by environment
- Silver nitrate exposure

3. Clinical findings

The Clinical presentation of Neonatal Conjuctivitis varies depending upon the severity and the type of infection. The signs and symptoms of ophthalmia neonatorum are similar for most of the infectious agents (Foster, 1995). Diffuse unilateral or bilateral redness due to injection of conjuctival vessels is the hallmark. Other common findings incude conjuctival oedema and discharge. More serious finding include keratitis and orbital celulitis, but also serious systemic involvement if left untreated (Woods, 2005; Zar, 2005). It is necessary to make accurate diagnosis in order to begin appropriate treatment which can help to reduce complications (Table 3).

3.1 Chemical conjunctivitis

It is present with mild injection of conjunctiva with minimal discharge. It is important that these occur within few hours after application of irritant. Sometimes the persistent redness of the eye might be folowed by purulent discharge and in that case there is a need for further laboratory investigation.

3.2 Bacterial conjunctivitis

The occurrence time and severity of clinical features depend on the type of microorganism.

Gonococal conjunctivitis

During this infection there is a severe redness, swelling of conjunctiva and eyeleads, and a lot of purulent drainage presenting few days after birth (Woods 2005), but may occur later as hyperacute conjunctival injection and chemosis, lid oedema and severe purulent discharge. Corneal ulceration and perforation may be associated features (Jackson, 2008).
Hyperacute conjunctivitis has the incubation period 1-7 days (Isenberg et al., 1996; Chandler et al., 1990), often bilateral and signs are more severe. Serosanguinous exudate may be replaced by mucopurulent discharge, with development of membranes. A disseminated gonococcal infection with arthritis, meningitis, pneumonia and sepsis that may lead to death of an infant is very rare.

Chlamydial conjunctivitis

Cervical infection with Chlamydia carries a risk to the neonate of 18-50% (Vaz et al., 1999; Schachter et al., 1986; Hollier et al., 2009; Roberts, 2009). The clinical features present at 5 to 14 days after birth with gradually worsening. Eyelids and conjunctiva are redness and swollen (Figure 1), and mucopurrulent drainage is present. It may also occur severe swelling and discharge with a course of 6 to 12 weeks (if left untreated) leading to scars of

conjunctiva and cornea. In this case, if untreated or even only topically treated, may worsen with upper respiratory infection, in severe cases with afebrile pneumonitis usually presenting at 2 to 20 months of age (Darville, 2005). Approximately 50% of infants with chlamydial pneumonitis have concurrent conjunctivitis or a recent history of conjunctivitis (Tarabishy et al., 2008).



Fig. 1. Neonatal conjuctivitis due to chlamydia trachomatis in a five days old infant

Staphylococcus conjunctivitis. Staphylococcus aureus can cause neonatal conjuctivitis with redness, swollen purulent discharge (Figure 2).



Fig. 2. Neonatal conjuctivitis due to staphylococcus aureus infection in an one week old infant.

3.3 Herpetic conjunctivitis

It is present usually the first two weeks of life with moderate injection, edema of conjuctiva and nonpurrulent discharge after vesicular skin lesions which can precede the eye involvment. In some cases it may be complicated with corneal clouding with dentritic or geographic corneal ulcers or upper respiratory infection (Rudolph, 2002). Systemic infection can cause jaundice, hepatosplenomegaly, pneumonitis, meningoencephalitis and disseminated intravascular coagulation.

Etiology	Onset after birth	Clinical findings
Chemical	3-36 hours	Mild injection, watery dicharge
Gonnococal	1-7 days	Injection and lead edema, purulent discharge
Chlamydial	5-14 days	Mild- severe injection, watery-purulent discharge, psudomembranes, chronicity, associated pneumonia
Herpetic	1-14 days	Watery discharge, injection and lead edema, associated keratitis

Table 3. Clinical findings of neonatal conjunctivitis by etiological factor modified from Rudolph's fundametntals of Pediatrics, 2002

4. Diagnosis

Prompt diagnosis is key in establishing proper treatment and minimizing potential serious complications of disease. An accurate diagnosis of conjunctivitis centers on taking a patient history to learn when symptoms began, how long the condition has been going on, the symptoms experienced, and other predisposing factors, such as upper respiratory complaints, allergies, sexually transmitted diseases, herpes simplex infections, and exposure to persons with pink eye. It may be helpful to learn whether an aspect of an individual's occupation may be the cause.

A thorough examination of the globe and periocular structures of a neonate suspected to have neonatal conjunctivitis is crucial. Corneal involvement should be investigated closely with and without fluorescein and blue cobalt light. Non-specific signs of neonatal conjunctivitis include conjunctival injection, tearing, mucopurulent or non-purulent discharge, chemosis, and eyelid swelling.

Diagnostic tests are usually not indicated unless initial treatment fails or an infection with gonorrhea or chlamydia is suspected. In such cases, the discharge may be cultured and stained to determine the organism responsible for causing the condition. Cultures and smears are relatively painless (Jackson, 2008).

Laboratory studies for suspected infectious etiology should include the following (Table 4 and 5):

- Conjunctival scraping, stains for Chlamydia. C. trachomatis is an obligate intracellular organism and exudates are not adequate for testing so conjunctival specimens for chlamydia testing must include conjunctival epithelial cells;
- Culture on chocolate agar for N gonorrhoeae ;

- Culture on blood agar for other strains of bacteria;
- Culture for HSV if vesicles present or is supicious of viral etiology;
- Direct antibody testing or Polymerase Chain Reaction (PCR) may also be indicated.

The laboratory studies may need to be repeated if symptoms worsen or recur following treatment.

Etiology	Laboratory diagnosis
Chemical	-
Gonnococal	Stain and cultures
Chlamydial	Stain, cultures, enzyme immunoassay, direct fluorescent antibody assay
Herpetic	Stain, cultures, antigen or DNA assay

Table 4. Laboratory diagnosis based on etiology

Modified from Rudolph's fundametntals of Pediatrics, 2002

Etiology	Conjuctival Scraping
Chemical	Minimal reactive cells to few polymorphonuclears
Gonococcal	Many reactive cells with gram negative intracellular dyplococci
Chlamydial	Many reactive cells with stain for basophilic cytoplasmic inclusion bodies or direct immunofluorescent assay
Other bacteria (Staphylococcus, Streptococcus, Haemophilus)	Stain for bacteria
Herpes simplex virus	Variable reactive cells with multinucleated giant cells

Table 5. Conjuctival scraping findings in ophtalmia neonatorum

Modified from Duane's Clinical Ophthalmology, 2008

5. Differential diagnosis

The differential diagnosis of neonatal conjunctivitis includes:

- Cellulitis (Orbital, Preseptal)
- Dacryocystitis
- Glaucoma, Primary or Secondary Congenital
- Keratitis, Bacterial, Fungal or Herpes Simplex

6. Complications

Complications usually can be divided concerning eye and/or systemic complications.
Ocular complications of neonatal conjunctivitis include pseudomembrane formation, corneal edema, thickened palpebral conjunctivia, peripheral pannus formation, corneal opacification, staphyloma, corneal perforation, endophthalmitis, loss of eye, and blindness.
Systemic complication due to Chlamydia infection
Systemic complications of chlamydia conjunctivitis include pneumonitis, otitis, pharyngeal and rectal colonization. Pneumonia has been reported in 10-20% of infants with chlamydial conjunctivitis.
Systemic complications due to gonococcal infection
Complications of gonococcal conjunctivitis and subsquent systemic involvement include arthritis, meningitis, anorectal infection, septicemia, and death.
The complications can be avoided if the proper treatment is initiated at time.

7. Treatment

7.1 Initial therapy

Ophtalmia neonatorum is treated with a broad-spectrum antibiotic e.g. ofloxacin 0.3% qds. When the microbiological results is present the treatment is based on microbiological cause (Jackason, 2008).

7.2 Chemical ophtalmia neonatorum

Chemical neonatal conjunctivitis usually disappears spontaneously within 2-4 days, and no treatment is required. The use of artificial tear is preferred.

7.3 Chlamydial ophtalmia neonatorum

The recommended regimen for chlamydial neonatal conjunctivitis is erythromycin base or ethylsuccinate, as a systemic therapy, 50mg per kg per day orally, divided into four doses per day for two weeks (Table 6). A follow-up of infants is recommended to determine whether initial treatment was effective because the efficacy is only approximately 80% and a second course of therapy might be required. Also, the evaluation of concomitant chlamydial pneumonia should be considered (Sexually transmitted disease treatment guidelines, 2010; Lippincott Williams & Wilkins, 2008; Yanoff & Duker, 2008).
The systemic treatment is administred as additional to topical treatment. (Sexually transmitted disease treatment guidelines, 2010). From local antibiotics usually are applied erythromycin 0.5% or tetracycline 1% eye ointment.
The mother and her sexual partners also should be treated with erythromycin base or ethylsuccinate (Sexually transmitted disease treatment guidelines, 2010).

7.4 Gonococcal ophtalmia neonatorum

The immediate treatment is needed because of complications such as corneal perforation and blindness. Gonococcus conjunctivitis is treated with ceftriaxone 25-50mg/kg IV or IM in a single dose (Table 6), not to exceed 125mg. An alternative regimen is cefotaxime 100mg/kg/24 hours IV or IM divided in two doses for seven days or 100mg/kg as a single dose. The irrigation with saline is preferred until the purulent discharge is cleared. The local

antibiotics such as bacitracin or erythromycin eye ointment are applied as additional therapy because topical antibiotic alone is inadequate. The atropine sulphate ointment should be applied if the cornea is involved (Sexually transmitted disease treatment guidelines, 2010; Lippincott Williams & Wilkins, 2008; Yanoff & Duker, 2008).
The mothers of infants and mother's sex partners should be evaluated and treated according to the recommendations for treating gonococcus infections in adults (Sexually transmitted disease treatment guidelines, 2010).
Neonatal conjunctivitis due to other bacteria usually respond to topical ointments containing bacitracin for gram positive stain bacteria, and tobramycin or ciprofloxacin for gram negative stain bacteria.

Type of bacteria	Drug	Dose for day	Duration
Chlamydia trachomatis	Erythromycin	50mg/kg	14 days
Nesseria gonorrhoeae	Ceftriaxone	25-50mg/kg	A single dose

Table 6. Recommended regimens for bacterial neonatal conjuctivitis

Modified from Sexually transmitted disease treatment guidelines 2010. Centers for Disease Control and Prevention, MMWR Recomm Rep 2010; 59 (RR-12): 53-54.

7.5 Herpetic ophtalmia neonatorum

Herpetic neonatal conjunctivitis is recommended to be treated with acyclovir 45-60mg/kg/day in three doses for 14 days in non disseminated disease and 21 days in disseminated disease. Local antiviral therapy is 1% trifluridine or 3% vidarabine or 0.1% iododeoxyuridine (drops or ointment) (Lippincott Williams & Wilkins, 2008).

8. Prophylaxis

8.1 Silver nitrate prophylaxis

German obstetrician Credé', in 1881, has applied 2% silver nitrate solution for prophylaxis of neonatal ophtalmia, resulting in a reduction of incidence from 7.8% to 0.17%. Thereafter was started instillation of silver nitrate, based on legislation, in most European countries and most of North America states in the first half of last century (Schneider, 1984; Crede CSR, 1881; Barasam, 1966). Latest in 1970s approximately half the United States specified 1% silver nitrate solution as the sole agent (Hammerschlag MR et al., 1908). In the United Kingdom the procedure has been discontinued, and in Japan and Australia, it was never used (Shaw EB, 1977). The mother usually can be representative consent of using of Credé's method in Sweden (Wahlberg V, 1982). The decision for changing of the Wisconsin law in 1980 that tetracycline and erythromycin could be used for prophylaxis against GON was based on a previous ruling by US Supreme Court (Whittaker N et al., 1981).
The siver nitrate, which by law is instilled within 1 hour after birth, may cause chemical conjunctivitis pain and visual impairment. The silver nitrate does not prevent all cases of gonococcal neonatal conjunctivitis. The chemical conjunctivitis caused by silver nitrate may mask the onset of gonococcus neonatal conjunctivitis (Shaw, 1977; Snowe et al., 1973).

Since 1940s, when antibiotics were developed the incidence of gonococcal neonatal conjunctivitis was decreased dramatically (Butterfield et al., 1981).
Recommendations of the US Centers for Disease Control (CDC) are supported from American Academy of Pediatrics in 1986 and 1988. According to these recommendations 1% tetracycline ointment and 0.5% erythromycin ointment were equally acceptable in preventing of gonococcus ophtalmia neonatorum. Although it was felt that silver nitrate might be the best agent in areas where the incidence of penicillinase-producing neisseria gonorrhoeae (PPNG) was appreciable (Peter, 1988).
The CDC's 1989 guidelines on the treatment of sexually transmitted diseases were unchanged with respect to the prevention of ophthalmia neonatorum (Sexually Transmitted Diseases Treatment Guidelines, 1989).
In Canada the incidence of PPNG among reported cases of gonorrhea increased from 0.5% in 1985 to 5.5% in 1989 (Status of penicillinase-producing Neisseria gonorrhoeae in Canada, 1991).
In 1989 the US Preventive Services Task Force recommended that 1% tetracycline ointment or 0.5% erythromycin ointment have to be applied topically to the eyes of all newborns as soon as possible after birth and no later than 1 hour after birth (Preventive Services task Forces, 1989).
Silver nitrate was not recommended since it is locally irritating, frequently causing chemical conjunctivitis, and has limited efficacy in preventing chlamydial ophthalmia neonatorum.

8.2 Povidon-iodine prophylaxis

In 1995, is reported the use of a 2.5% povidone-iodine solution for prophylaxis of ophtalmia neonatorum in Kenya, and was found to be more effective than treatment with erythromycin or silver nitrate for prophylactic purposes. Also, the povidone-iodine was less toxic and it costs less (Isenberg et al., 1995).
The povidone-iodine prophylaxis against ophtalmia neonatorum, applied twice in the first postnatal day over a single application at birth, revealed with no advantage. It was supported the original notion of Crede in 1881 that a single drop of an effective medication given at birth is the best way to prevent the development of ophtalmia neonatorum. The povidone-iodine applications approximately 24 hours later were with no further benefit.

8.3 Antibiotics prophylaxis

The procedure for prevence of gonococcal ophthalmia neonatorum is required by law in most states. Prophylactic agent should be instilled into the eyes of newborns. But, the efficacy of prophylactic agents in preventing chlamydial ophthalmia is clearless, and they do not eliminate nasopharyngeal colonization by C. trachomatis.
This preparation should be instilled into both eyes of every neonate as soon as possible after delivery. Ideally, ointment should be applied using single-use tubes or ampoules rather than multiple-use tubes. If prophylaxis is delayed (i.e., not administered in the delivery room), a monitoring system should be established to ensure that all infants receive prophylaxis. All infants should be administered ocular prophylaxis, regardless of whether they are delivered vaginally or by cesarean section.
Antibiotics that are applied in prevention of gonococcal ophtalmia are tetracycline and erythromycin and are more effective than silver nitrate (Rothenberg, 1979; American Academy of Pediatrics, 1980). Erythromycin is less effective than tetracycline against sensitive isolates of N. gonorrhoeae in vitro. Canadian Paediatric Society in 2010 has revised recommandations for the prevention of neonatal ophthalmia due to N gonorrhoeae (Table 7).

Recommendation	Category	Grade
Prophylaxis to prevent neonatal ophthalmia due to N gonorrhoeae should be provided to all infants.	A	1
Physicians and their patients may choose among the recommended prophylactic agents - that is, 1% silver nitrate solution in single-dose ampoules, or an ointment containing 0.5% erythromycin base or 1% tetracycline hydrochloride in single-dose tubes.	A	1
The use of povidone-iodine for ophthalmia prophylaxis.	C	1
To prevent potential cross-contamination, a separate ampoule or tube should be used for each eye. Ampoules and tubes should be discarded after use.	A	3
When 1% silver nitrate solution is used, each eyelid should first be wiped gently with a sterile cotton ball to remove foreign matter and permit adequate eversion of the lower lid. Two drops of solution are placed in each lower conjunctival sac. The closed eyelids can be massaged gently to help spread the solution to all areas of the conjunctiva. After 1 min, any excess silver nitrate should be gently wiped from the eyelids and surrounding skin with sterile cotton.	A	3
When an ophthalmic ointment (tetracycline or erythromycin) is used, the eyelids should be prepared as for the application of silver nitrate. A line of ointment 1 to 2 cm long is placed in each lower conjunctival sac, if possible covering the whole lower conjunctival area. Care is needed to prevent injury to the eye or the eyelid from the tip of the tube. The closed eyelids can be massaged gently to help spread the ointment. After 1 min, any excess ointment should be wiped gently from the eyelids and surrounding skin with a sterile cotton.	A	3
The eyes should not be irrigated after instillation of a prophylactic agent. Irrigation may reduce the efficacy of the agent and probably does not decrease the incidence of chemical conjunctivitis caused by silver nitrate.	A	3
Prophylaxis should be given as soon as possible after birth. However, delaying prophylaxis for up to 1 h after birth probably does not impair the agent's efficacy.	B	3
A check system should be established to ensure that all infants are treated.	A	3
Infants born by caesarian section should also receive prophylaxis.	B	3
Pregnant women should be screened for infection by N gonorrheoae and C trachomatis during pregnancy and their identified infections should be treated during pregnancy.	A	3
Infants born to women with gonococcal infection discovered during labour or at the time of delivery should be given a single dose of ceftriaxone (25 to 50 mg/kg) or cefotaxime (100 mg/kg) in addition to topical prophylaxis.	A	2

Table 7. Recommandations for the prevention of neonatal ophthalmia due to N gonorrhoeae

Modified from Canadian Pediatric Society. Revised Recommandations for the prevention of neonatal ophtalmia, 2010.
Classification used to determine the strength of the recommendations and the quality of the evidence on which the recommendations are based.

Category	Definition
A	Good evidence to support a recommendation for use
B	Moderate evidence to support a recommendation for use
C	Insufficient evidence to support a recommendation for or against use
D	Moderate evidence to support a recommendation against use
E	Good evidence to support a recommendation against use
Grade	
1	Evidence from at least one properly randomized, controlled trial
2	Evidence from at least one well-designed clinical trial without randomization, from cohort or case- controlled analytic studies, preferably from more than one centre, from multiple time series, or from dramatic results in uncontrolled experiments
3	Evidence from opinions or respected authorities on the basis of clinical experience, descriptive studies or reports of expert committees

Source. Canadian Pediatric Society. Revised Recommandations for the prevention of neonatal ophtalmia, 2010.

Table 8.

Tetracycline as silver nitrate does not prevent completely chlamydial ophtalmia neonatorum (Laga et al., 1988, Canadian Task Force on the Periodic Health Examination, 1992). There were no significant differences between the rates of chlamydial ophtalmia neonatorum when prophylaxis with erythromycin was compared with prophylaxis with tetracycline or silver nitrate. For a modest reduction in chlamydial ophtalmia neonatorum now are recommended the agents for gonococcal prophylaxis.
Erythromycin 0.5 % is the only antibiotic ointment recommended for use in neonates in each eye in a single application. Silver nitrate and tetracycline ophthalmic ointment are no longer manufactured in the United States, bacitracin is not effective, while povidone iodine has not been studied adequately (Sexually Transmitted Diseases Treatment Guidelines, 2010).
If erythromycin ointment is not available, infants at risk for exposure to N. gonorrhoeae (especially those born to a mother with untreated gonococcus infection or who has received no prenatal care) can be administered ceftriaxone 25-50 mg/kg IV or IM, not to exceed 125 mg in a single dose (Sexually Transmitted Diseases Treatment Guidelines, 2010).
The diagnosis and treatment of gonococcal and chlamydial infections in pregnant women is the best method for preventing neonatal gonococcal and chlamydial disease. Also preventative measures include proper hand-washing techniques by peripartum and nursery staff.

9. Prognosis

- Chlamydial infection: good - 80% fully recover after one course of treatment.
- Bacterial infection: rarely fails to respond to appropriate treatment.
- Viral infection: the ocular prognosis can be poor and the systemic sequelae may be fatal.
- Chemical irritation: good - full spontaneous recovery expected after 24-36 hours.

10. References

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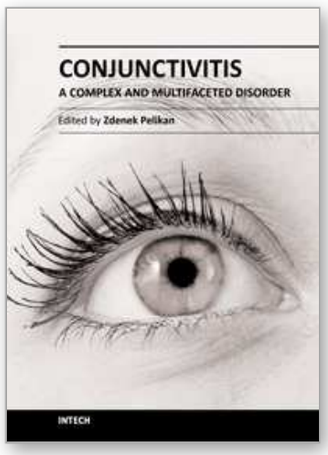
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Conjunctivitis - A Complex and Multifaceted Disorder
Edited by Prof. Zdenek Pelikan

ISBN 978-953-307-750-5
Hard cover, 232 pages
Publisher InTech
Published online 23, November, 2011
Published in print edition November, 2011

This book presents a number of interesting and useful aspects and facets concerning the clinical features, properties and therapeutical management of this condition. Dr. H. Mejía-López et al. present an interesting survey of the world-wide epidemiologic aspects of infectious conjunctivitis. Dr. U. Ubani evaluates conjunctival symptoms/signs participating in the clinical features of this disorder. Dr. A. Robles-Contreras et al. discuss immunologic aspects underlying possibly the conjunctivitis. Dr. Z. Pelikan presents the cytologic and concentration changes of some mediators and cytokines in the tears accompanying the secondary conjunctival response induced by the nasal challenge with allergen. Dr. S. Sahoo et al. summarize the treatment and pharmacologic control of particular clinical forms of conjunctivitis in general practice. Dr. S. Leonardi et al. explain the basic pharmacologic effects of leukotriene antagonists and their use for the treatment of allergic conjunctivitis. Dr. J.A. Capriotti et al. evaluate the therapeutical effects of various anti-adenoviral agents on the acute conjunctivitis caused by adenovirus. Dr. V. Vanzzini-Zago et al. assess the prophylactic use and efficacy of "povidone-iodium solution", prior the ocular surgery. Dr. F. Abazi et al. present the clinical features, diagnostic and therapeutical aspects of "neonatal conjunctivitis". Dr. I.A. Chaudhry et al. review the special sub-form of conjunctivitis, being a part of the "Trachoma". Dr. B. Kwiatkowska and Dr. M. Maślińska describe the clinical, pathophysiologic and immunologic features of conjunctivitis. Dr. S. Naem reviews the conjunctivitis form caused by Thelazia nematodes, occurring principally in animals.

How to reference
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Flora Abazi, Mirlinda Kubati, Blerim Berisha, Masar Gashi, Dardan Koçinaj and Xhevdet Krasniqi (2011). Ophtalmia Neonatorum, Conjunctivitis - A Complex and Multifaceted Disorder, Prof. Zdenek Pelikan (Ed.), ISBN: 978-953-307-750-5, InTech, Available from: http://www.intechopen.com/books/conjunctivitis-a-complex-and-multifaceted-disorder/ophtalmia-neonatorum

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InTech Europe
University Campus STeP Ri
Slavka Krautzeka 83/A
51000 Rijeka, Croatia
Phone: +385 (51) 770 447

InTech China
Unit 405, Office Block, Hotel Equatorial Shanghai
No.65, Yan An Road (West), Shanghai, 200040, China
中国上海市延安西路65号上海国际贵都大饭店办公楼405单元
Phone: +86-21-62489820

Fax: +385 (51) 686 166
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