Bacterial Conjunctivitis

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Amar Bhat and Vishal Jhanji

1.1 Introduction

Bacterial conjunctivitis is a relatively common infection that affects the bulbar and palpebral conjunctiva. Most often, bacterial conjunctivitis is treated empirically by general practitioners rather than ophthalmologists. Presenting symptoms usually include redness and discharge, and the time course of the condition can vary from hyperacute to chronic. Treatment usually consists of topical antibiotic drops, which facilitate resolution and decrease morbidity; some atypical causes of bacterial conjunctivitis may require additional treatment.

1.2 Epidemiology

Patients with bacterial conjunctivitis most often present initially to their primary care provider (PCP) rather than an ophthalmologist. Ocular problems comprise 1–4% of consultations to PCPs, and bacterial conjunctivitis was the most common diagnosis that providers made [1–3]. It is difficult to know the true incidence of bacterial conjunctivitis as cultures are not routinely obtained before topical antibiotic therapy is instituted. It is likely that PCPs over-diagnose bacterial conjunctivitis, as topical antibiotics are prescribed in most cases of suspected acute infective conjunctivitis, of which only half may be bacterial [4]. Bacterial culture results from a tertiary care center demonstrated that the most common bacterial isolates in bacterial conjunctivitis were *Staphylococcus aureus*, coagulase-negative *Staphylococcus*,

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Streptococcus pneumoniae, and *Haemophilus*; other bacteria, including *Chlamydia*, made up a minority of the cases [5, 6].

1.3 Risk Factors

The ocular surface is generally resistant to infection due to a multitude of natural defense mechanisms. Utilization of the innate and adaptive immune system in combination with the anatomically protective ocular surface contributes to the natural resilience of the conjunctiva [7]. Tears not only flush the eye of pathogens, but they also contain other protective components such as immunoglobulins, lysozyme, and lactoferrin [8–9]. The normal flora of the conjunctiva includes *Staphylococcus epidermidis*, *Propionibacterium acnes*, *Streptococcus*, and *diphtheroids*, and these bacteria may serve a protective role by secreting antibiotic-like substances or acidic metabolic waste products [2, 10].

Interruptions of the normal ocular surface appear to be a risk factor for bacterial conjunctivitis. Ocular surface disease such as dry eye, deep fornix syndrome, ectropion and entropion, defective tear film, systemic immunosuppression, prior infections, ocular trauma, history of hospitalization, and cosmetic application practices (in females) have been associated with ocular bacterial infections [11–14].

1.4 Classification

Bacterial conjunctivitis should be classified by its time course (hyperacute, acute, or chronic), exudation (mucoid, mucopurulent, or purulent), and other remarkable features (membranes, pseudomembranes, granulomas). Classically, hyperacute purulent conjunctivitis would suggest *Neisseria gonorrhoeae* as the pathogen, while chronic conjunctivitis in a patient with deep fornices could suggest *Staphylococcus aureus* in many cases. Due to the variability of duration and symptoms with which patients may present, the gold standard of pathogen determination remains Gram stains and conjunctival cultures.

1.5 Symptoms

Patients with bacterial conjunctivitis frequently present with bilateral symptoms, though unilateral disease is not uncommon. Patients with unilateral risk factors may be more prone to developing unilateral disease. Symptoms of bacterial conjunctivitis commonly include redness, foreign body sensation, discharge, and itching. Eyelids feeling “stuck” together in the morning is another common symptom. If symptoms are initially unilateral, they may develop contralateral symptoms within a couple of days. Lid swelling, fullness, or erythema may also be present, especially in cases of blepharoconjunctivitis. It is difficult to discern between bacterial and viral conjunctivitis using symptomatology alone [15–16].

The duration of bacterial conjunctivitis in combination with clinical findings may point towards a specific causative organism. Hyperacute conjunctivitis

typically presents with severe purulent discharge and has rapid onset and progression. Acute conjunctivitis is defined as an onset of less than 4 weeks, whereas chronic conjunctivitis is defined as longer than 4 weeks in duration.

1.6 Signs

Findings in bacterial conjunctivitis may include injection, tearing, discharge, papillae, follicles, membranes, granulomas, or cicatricial changes. Conjunctival injection, a nonspecific sign caused by dilation of the conjunctival blood vessels, is useful in monitoring the progression of disease or response to treatment (Fig. 1.1). Reflex tearing is common due to irritation of the ocular surface. In early stages of bacterial conjunctivitis, more serous discharge may be noted. Accumulation of dead tissue, degenerated white blood cells, and bacteria contribute to the purulence of the discharge (Fig. 1.2). As goblet cells begin secreting more mucus, discharge can become more

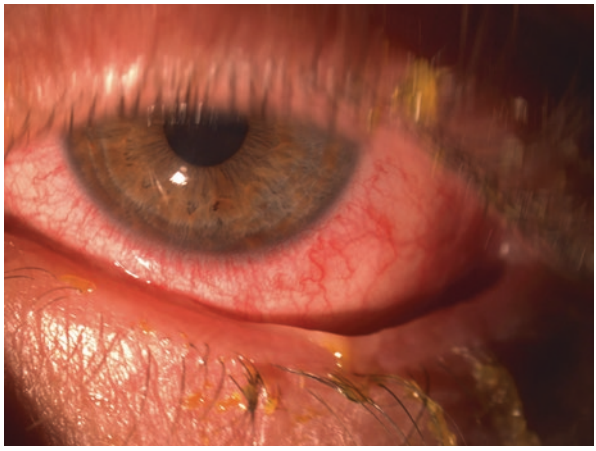

Fig. 1.1 Slit lamp photograph showing conjunctival congestion in a patient with bacterial conjunctivitis

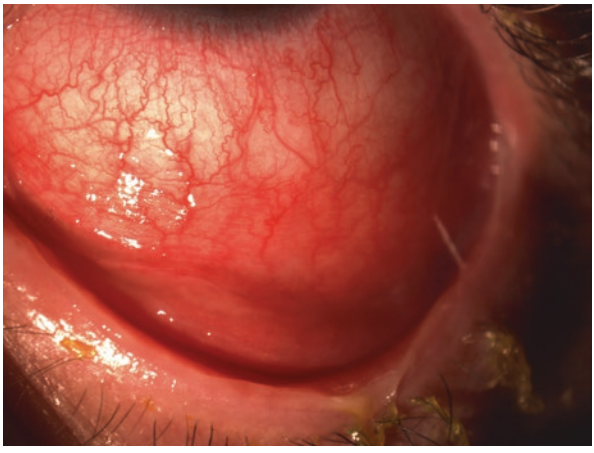

Fig. 1.2 Slit lamp photograph showing purulent ocular discharge in the lower fornix in a patient with bacterial conjunctivitis

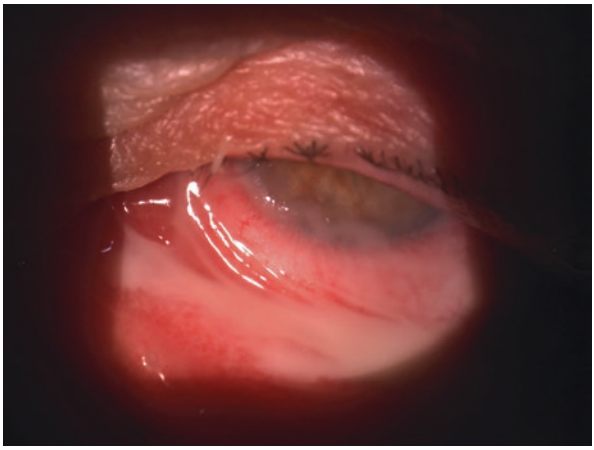

Fig. 1.3 Slit lamp photograph showing copious conjunctival discharge in *Neisseria* conjunctivitis

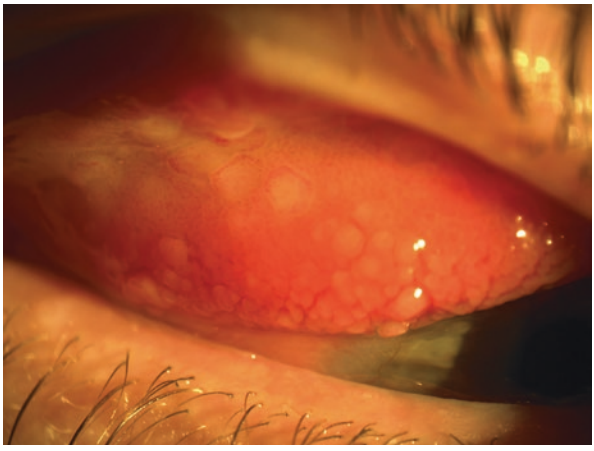

Fig. 1.4 Slit lamp photograph showing papillary response on everted upper lid in bacterial conjunctivitis

mucopurulent. Purulent (rather than mucopurulent) discharge is classically seen with *Neisseria* conjunctivitis, though other causes have been reported (Fig. 1.3) [17].

1.6.1 Papillae

Papillae are elevations in the conjunctiva with a central fibrovascular core. Papillae occur where the conjunctiva is anchored to underlying tissue by septae, which are fibrous connections of the conjunctival epithelium to the underlying substantia propria. The fibrous connections are the microscopic structural guides that allow the formation of individual papillae, usually less than 1 mm in diameter. With slit lamp examination, papillae are visible as small elevations, usually with a flat-top, with central pinpoint red dots which represent their central blood vessels (Fig. 1.4). Arborization of the blood vessels is also sometimes seen at the surface. The normal palpebral conjunctiva has blood vessels arranged in a radial pattern, extending from

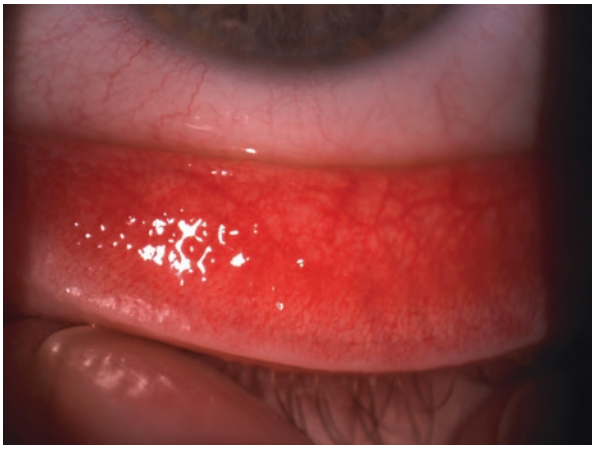

Fig. 1.5 Follicular response in lower fornix in *Chlamydial* conjunctivitis

the fornix to the lid margin. Due to the hypertrophy of the superficial layers of the palpebral conjunctiva in papillary conjunctivitis, the normal underlying vasculature of the palpebral conjunctiva is often obscured. The presence of papillae is a nonspecific marker of conjunctival inflammation (acute or chronic) [17].

Giant papillae are formed when there is breakdown of intervening septae between papillae, allowing the smaller papillae to coalesce. Giant papillary conjunctivitis usually occurs as a result of chronic inflammation and is commonly seen in vernal keratoconjunctivitis, atopic keratoconjunctivitis, or secondary to chronic exposure to foreign bodies (contact lenses, loose sutures, prostheses). Bacterial conjunctivitis does not classically cause giant papillae.

1.6.2 Follicles

Follicles are dome-shaped elevations in the conjunctiva without a central blood vessel and are usually more whitish or translucent than papillae (Fig. 1.5). Follicles often have a surrounding, circumferential blood vessel in contrast to papillae. Similar to lymph node follicles, the histology of conjunctival follicles demonstrates aggregates of lymphocytes; germinal centers and a surrounding mantle zone can also be seen. Follicles can be seen normally in children without conjunctivitis or other pathologies. The presence of follicles is more specific than that of papillae, though bacteria are not a classic cause of acute follicular conjunctivitis. However, *Chlamydia*, *Moraxella*, and Lyme disease from *Borrelia burgdorferi* have all been reported to cause a chronic follicular conjunctivitis [13, 18–20].

1.6.3 Membranes and Pseudomembranes

Membranes and pseudomembranes are pale-colored sheets of fibrin and inflammatory debris that occur when discharge coagulates on the conjunctival surface. Histologically, a true membrane also incorporates the conjunctival epithelium with

the growth of capillaries into the membrane; this results in bleeding when the membrane is peeled [21–22]. Although it is classically taught that pseudomembranes do not bleed when peeled, bleeding is still often observed with pseudomembrane peeling due to the severe inflammation and friability of the underlying conjunctiva. Bacterial causes of membranous and pseudomembranous conjunctivitis include beta-hemolytic streptococci, *Neisseria*, *Corynebacterium*, and *Chlamydia*. Noninfectious causes most commonly include chemical burns, Stevens-Johnson syndrome, and ocular cicatricial pemphigoid. Pseudomembranous conjunctivitis has also been reported in giant fornix syndrome [14].

1.6.4 Granulomas

Granulomas appear as nodular changes of the conjunctival stroma which can sometimes be confused with follicles. Granulomas can be necrotizing or non-necrotizing and be caused by infectious or noninfectious causes. Noninfectious causes of conjunctival granulomas include sarcoidosis and foreign bodies, whereas infectious causes can include syphilis, tuberculosis, *Bartonella henslae*, *Francisella tularensis*, and *Sporothrix shenckii* [23]. The diagnosis of Parinaud oculoglandular syndrome is made when there is a unilateral granulomatous and follicular conjunctivitis with a swollen preauricular lymph node. Clinical history is important to help determine the likely etiology if biopsy cannot be performed.

1.6.5 Cicatricial Changes

Cicratrization of the conjunctiva can occur in various conjunctival pathologies. Cicatricial changes can include formation of symblepharon or ankyloblepharon, cicatricial entropion, shortening of the fornices, and linear or stellate conjunctival scars [24]. Over time, loss of goblet cells contributes to keratinization of the conjunctiva and cornea. Classical causes of cicatricial conjunctivitis are noninfectious or autoimmune, though bacterial cicatricial conjunctivitis has been seen with *Chlamydia*, *Corynebacterium*, and *Streptococcus*.

1.7 Acute Bacterial Conjunctivitis

Bacterial conjunctivitis is most often seen in the acute setting, with an estimated annual incidence rate of 135 per 10,000 in the United States [25]. Most acute bacterial conjunctivitis is seen by providers who are not eye specialists, and topical antibiotics are frequently prescribed for treatment. Topical antibiotics have demonstrated to speed the resolution of symptoms and infection and were not shown to have any serious side effects [26].

Acute bacterial conjunctivitis in children is most commonly due to *Haemophilus influenzae*, although *Streptococcus* and *Staphylococcus* conjunctivitis is common as

well [15]. *Moraxella* conjunctivitis has also been reported with a high incidence in some studies, and one study showed transmission among multiple students in a Navajo boarding school [13, 27]. Clinical history may provide important clues to the etiologic agent, though it is not nearly specific enough to replace conjunctival cultures. Children with concurrent otitis and conjunctivitis were more likely to have *Haemophilus* conjunctivitis, while concurrent pharyngitis and conjunctivitis may hint at an adenoviral conjunctivitis [28]. In newborns, chlamydial conjunctivitis is one of the most common causes of ophthalmia neonatorum and may develop in 30–50% of infants born to mothers with proven exposure to chlamydia [29].

In adult conjunctivitis, *Staphylococcus aureus*, coagulase-negative *Staphylococcus*, and *Streptococcus pneumoniae* are seen more frequently than *Haemophilus* [5, 6]. *Moraxella* conjunctivitis, although less common, may present with an acute or chronic conjunctivitis with or without follicles [6, 13]. The frequency and etiology of conjunctivitis may vary based on a number of factors, from climate to hygiene. Seasonal changes may contribute to the frequency of bacterial conjunctivitis, with two studies demonstrating that bacterial conjunctivitis was more common in winter [28, 30].

Spirochetes have been known to cause conjunctivitis as well. *Borrelia burgdorferi*, the spirochete that causes Lyme disease, may cause a follicular conjunctivitis in around 10% of patients with early Lyme disease [19–20]. Keratitis with nummular infiltrates and uveitis or neuro-ophthalmic manifestations will often occur months later in Lyme disease. *Treponema pallidum*, the spirochete responsible for syphilis, may rarely present as a papillary conjunctivitis [31].

Chlamydia trachomatis serotypes D-K are the cause of inclusion conjunctivitis in neonates and sexually active individuals. In sexually active individuals, the conjunctivitis often presents in a chronic setting, although sometimes it may be misdiagnosed if seen acutely. In neonates, ophthalmia neonatorum is the broad name for various conjunctivitis conditions that may occur within a few weeks after birth [29]. Mothers with chlamydial cervicitis who undergo vaginal delivery have a 50–75% chance of passing the *C. trachomatis* to their newborn. Incubation takes approximately 1 week, though onset of neonatal inclusion conjunctivitis may occur earlier if there was premature rupture of membranes. Typical onset for neonatal inclusion conjunctivitis is 5–14 days after birth. Symptoms may vary from mild (mild injection and watery discharge) to severe (eyelid edema, pseudomembrane formation, severe mucopurulent discharge). Newborns diagnosed with chlamydial conjunctivitis require 14 days of systemic erythromycin to prevent vision loss. Additionally, the mother of the baby and any sexual partners of the mother should be treated as well [29]. Trachoma and non-neonatal inclusion conjunctivitis will be discussed further in the Sect. 1.10.

The clinical course of conjunctivitis will vary depending on the virulence of the pathogen, though most cases of bacterial conjunctivitis are self-limited. In general, there will be a short incubation period followed by beginning of symptoms (redness, irritation, sticky eyelids in the morning). The conjunctivitis will worsen and often spread to the contralateral eye within the first week. The peak of the conjunctivitis is usually within 2–3 days of symptom onset. Without treatment, most bacterial

conjunctivitis will resolve within 2 weeks, although topical antibiotics can speed up the resolution of the infection [26]. Exact treatment regimens vary, and success has been reported using a variety of different topical antibiotic drops and ointments. Ointments may blur vision, so use of ointments is often not preferred by patients. Many providers often begin treatment with broad-spectrum topical antibiotics and tailor treatment if the conjunctivitis is refractory. One point of concern is the potential for antibiotic resistance; topical surgical prophylaxis has possibly contributed to an increase in quinolone-resistant *Staphylococcus* from endophthalmitis samples [6]. Bacteria can develop resistance to second- and third-generation quinolones with a single mutation, and resistance to fourth-generation quinolones requires an additional mutation, so repeated or extended treatment with topical antibiotics should be avoided if possible.

1.7.1 Complications

Although the course of most acute bacterial conjunctivitis is self-limited, there is a theoretical risk in increasing the bacterial burden on the eye. Potential complications of bacterial conjunctivitis include preseptal cellulitis, corneal ulceration, corneal perforation, symblepharon formation, cicatricial entropion, and xerosis. Blood cultures should be considered in children with *Haemophilus* conjunctivitis due to the possibility of septicemia, especially if there are any other concurrent issues like otitis media.

1.8 Hyperacute Bacterial Conjunctivitis

Conjunctivitis that rapidly progresses with copious purulent discharge, conjunctival injection, chemosis, and lid swelling is known as hyperacute purulent conjunctivitis. The purulent discharge will rapidly reappear after saline lavage or debridement. Lid swelling may be so severe that it can mimic preseptal cellulitis and even orbital cellulitis if ocular motility appears limited. A preauricular lymph node may be palpable. The most common causes of hyperacute purulent conjunctivitis are the gram-negative diplococci *Neisseria gonorrhoeae* and *Neisseria meningitidis*. *N. gonorrhoeae* affect newborns and sexually active people, whereas *N. meningitidis* may occur in patients of any age exposed to meningococcus [32–33]. Less commonly, other pathogens that typically cause mucopurulent conjunctivitis may produce a hyperacute purulent conjunctivitis in the setting of immunosuppression.

In neonates, gonococcal conjunctivitis most often presents 2–7 days after birth with copious purulent discharge. The incidence of gonococcal conjunctivitis is significantly lower than chlamydial conjunctivitis in the newborn, but 30–42% of infants born to mothers with *N. gonorrhoeae* may develop gonococcal conjunctivitis in the absence of appropriate prophylaxis [29]. Left untreated, gonorrheal ophthalmia neonatorum can progress to ulceration, endophthalmitis, perforation, or otherwise permanent vision loss within 24 h. Infants with gonorrheal ophthalmia

neonatorum should be treated with frequent conjunctive lavage and intramuscular or intravenous ceftriaxone (25–50 mg/kg, up to 125 mg) and evaluated for disseminated gonococcal disease. The infant's mother and her sexual partners should also be treated. Infants born to mothers with known gonococcal infections should be treated with a single prophylactic dose of ceftriaxone or cefotaxime.

In sexually active individuals, autoinoculation of *N. gonorrhoeae* is the most common method of transmission, although transmission can also occur via direct ocular exposure to body fluids [34]. There is classically a concurrent genitourinary gonococcal infection, although this may not be symptomatic which can lead to delays in diagnosis. Treatment for gonococcal conjunctivitis depends on the presence or absence of corneal findings. In addition to saline lavage, gonococcal conjunctivitis requires a single dose of intramuscular ceftriaxone 1 g, a single dose of oral azithromycin 1 g, and a topical fluoroquinolone eyedrop or ointment. For gonococcal keratoconjunctivitis, admission to the hospital and the above therapies are required, but the ceftriaxone should instead be administered intravenously (instead of intramuscularly) 1 g every 12 h until significant clinical improvement is noted. Treatment for chlamydial coinfection is required, as well as treating their sexual contacts with oral antibiotics for both gonorrhea and chlamydia [35].

Meningococcal conjunctivitis can also be a rare cause of ophthalmia neonatorum, with a presentation similar to gonococcal conjunctivitis [33]. Patients treated with systemic antibiotics for primary meningococcal conjunctivitis (PMC) were less likely to develop invasive meningococcal disease (IMD), so topical antibiotics should not be used alone. Success was reported in treating PMC with 5 days of oral penicillin to 10 days of oral cefprozil, but no firm guidelines exist. If patients develop IMD, they require 7 days of intravenous ceftriaxone [33].

1.9 Complications

The severity of potential ophthalmic complications in hyperacute purulent conjunctivitis necessitates adequate treatment and monitoring. Due to the virulence of *Neisseria*, keratitis, corneal ulceration or perforation, and even endophthalmitis can occur in gonococcal and meningococcal conjunctivitis [33, 35–36]. In one study, limbal anterior stromal infiltrates were the most common corneal finding; these infiltrates were considered to be manifestations of hypersensitivity rather than a bacterial infiltrate [35].

Systemic morbidity is secondary to the often concurrent genitourinary gonococcal infections. Additionally, coinfection with *Chlamydia* and other sexually transmitted infections is common, so systemic therapy for patients and their sexual partners for gonorrhea and chlamydia is warranted to prevent potentially devastating sequelae such as pelvic inflammatory disease [37]. Work-up for other sexually transmitted infections should also be considered. *Neisseria meningitidis* conjunctivitis may also harbor a risk or developing invasive meningococcal disease. Because of the transmissibility through respiratory droplets, antibiotic chemoprophylaxis should also be instituted in close contacts of patients with positive cultures for *N. meningitidis* [33].

1.10 Chronic Bacterial Conjunctivitis

Conjunctivitis that has lasted for longer than 4 weeks is considered to be chronic conjunctivitis. Bacterial infections are relatively common causes of chronic conjunctivitis in the developed world, but they should nonetheless be considered in the differential diagnosis if appropriate.

1.10.1 Chlamydial Conjunctivitis

Chlamydia trachomatis can cause multiple distinct forms of conjunctivitis: trachoma, inclusion conjunctivitis, lymphogranuloma venereum, and ophthalmia neonatorum. The non-neonatal variations all cause a chronic follicular conjunctivitis with palpable or tender preauricular lymph nodes, but the variations are discrete for multiple reasons.

1.10.1.1 Trachoma

Although uncommon in the developed world, trachoma is the world's leading cause of infectious blindness [38]. Trachoma classically affects people in the developing world who are in relative poverty [38–39]. Additional risk factors, most of which correlate to socioeconomic status, include lack of access to water supply, facial cleanliness, and overcrowding.

In active or inflammatory trachoma, there is chronic inflammation of the conjunctiva caused by *Chlamydia trachomatis* serotypes A-C. Most commonly, this occurs in children less than 5 years of age. With aging, active trachoma decreases in incidence while cicatricial trachoma increases in incidence. Left untreated, up to 90% of patients will develop some degree of cicatricial trachoma over 25 years of age, though scarring itself will usually begin in late childhood and early adulthood. Women are more likely to develop cicatricial trachoma than men, likely due to their increased exposure to *C. trachomatis* while caring for young children [39].

Classic symptoms of active trachoma include irritation, foreign body sensation, discharge (which be mild), eyelid swelling, and photophobia. Signs of active trachoma, primarily seen on the everted upper lid, include follicular conjunctivitis and papillary hypertrophy. Active trachoma may be underdiagnosed due to the potential for children to be asymptomatic or with mild irritation that may be mistakenly considered "normal."

Cicatricial trachoma signs include scarring of the palpebral conjunctiva, scarring of limbal follicles (round, pigmented depressions known as Herbert's pits), entropion and lid distortion secondary to conjunctival scarring, and trichiasis. Palpebral conjunctival scarring can occur at any place in the palpebral conjunctiva; the formation of a horizontal, linear scar just superior to the eyelid margin is known as Arlt's line. Due to mechanical trauma to the cornea from trichiatic lashes and palpebral conjunctival scarring, corneal sequelae are common and potentially blinding in trachoma. Superficial pannus, diffuse punctate epithelial keratopathy, epithelial defects, ulceration, and scarring are all very realistic sequelae of cicatricial

trachoma. Findings are often worse on the superior cornea due to the propensity of trachoma to affect the upper lid.

As a preventable cause of blindness, goals of trachoma management are preventative in nature. The SAFE (Surgery for trichiasis, Antibiotics, Facial cleanliness, Environmental improvement) effort is the World Health Organization's (WHO) primary strategy to eliminate blindness from trachoma worldwide. Surgery for trichiasis and entropion decrease the likelihood of corneal opacification and blindness; antibiotics have been shown to lower infection rates and can improve clinical signs; facial cleanliness and environmental improvements are aimed at improving the hygiene-related risk factors for trachoma in the community.

Surgery to prevent corneal opacification is dependent on each patient's particular needs. Epilation may be appropriate as a temporizing measure or in mild trachoma, while bilamellar tarsal rotation and posterior lamellar tarsal rotation procedures are recommended by the WHO. Primary limitations for surgical intervention in the SAFE strategy include awareness, fear, perceived costs, and access.

Antibiotic therapy can vary based on availability and of medications, but standard treatment includes either a single dose of azithromycin (20 mg/kg, up to 1 g) or topical tetracycline ointment twice daily for 6 weeks. Due to the difficulty of maintaining compliance with topical tetracycline ointment, a single dose of azithromycin is preferable if available.

For patients already with corneal opacification from trachoma, penetrating or lamellar keratoplasty are options to improve vision. Corneal transplantation is reserved for patients who have already optimized the ocular surface and addressed eyelid issues, as persistent entropion and trichiasis after keratoplasty would lead to poor graft survival. Availability and postoperative care limit the number of patients with trachoma-related corneal opacification who can receive corneal transplants, and penetrating keratoplasty in trachoma was considered to have a poor prognosis. However, a 2008 study of 127 eyes demonstrated 76.6% penetrating keratoplasty graft survival rate of 5 years for patients with trachomatous corneal scarring [40].

1.10.1.2 Inclusion Conjunctivitis

Non-neonatal inclusion conjunctivitis, sometimes known as adult inclusion conjunctivitis, is a chlamydial conjunctivitis that is considered a sexually transmitted infection [18]. Inclusion conjunctivitis is much more common in the developed world compared to trachoma, as *C. trachomatis* serotypes D-K are the most common cause of cervicitis in women and urethritis in men. The same serotypes D-K are responsible for neonatal chlamydial conjunctivitis. Similar to *N. gonorrhoeae* conjunctivitis, self-inoculation and genital-ocular contact are the primary modes of transmission for this conjunctivitis. Symptoms include redness, irritation, foreign body sensation, tearing, and mucopurulent discharge. Examination reveals a follicular conjunctivitis that may also be present on the superior palpebral conjunctiva. Subepithelial infiltrates can also be seen [18, 41].

Although patients may present in the acute stage of their illness, treatment with standard antibiotics used in acute bacterial conjunctivitis will often fail to treat

inclusion conjunctivitis. This leads to the development of a chronic follicular conjunctivitis in many patients.

Inclusion conjunctivitis in sexually active individuals does not respond well to topical antibiotics. Multiple antibiotics have been shown to be effective in treating including conjunctivitis, though most common regimens are azithromycin 1 g (single dose or two doses given a week apart), doxycycline 100 mg twice daily for 7–10 days, or erythromycin 500 mg four times daily for 7–10 days.

1.10.1.3 Lymphogranuloma Venereum

Chlamydia trachomatis serotypes L1-L3 are causative agents of the sexually transmitted infection lymphogranuloma venereum (LGV) which typically results in a genital ulcer disease. Conjunctivitis appears to be the most common ocular manifestation of LGV, although ocular involvement appears to be very rare. Parinaud's oculoglandular syndrome with peripheral keratitis and perforation has been reported in one instance of ocular LGV, and another series reported conjunctivitis and keratitis in LGV [42–43]. Diagnosis of LGV can be made through serology.

Treatment for LGV usually consists of 21 days of oral doxycycline therapy, though other medications and regimens may work as well [44]. The patient with Parinaud's oculoglandular syndrome in LGV was treated successfully with 6 weeks of oral tetracycline [42].

1.10.2 Deep Fornix Syndrome

Deep fornix syndrome, also known as giant fornix syndrome, is a relatively underdiagnosed cause of recurrent and chronic mucopurulent conjunctivitis in the elderly. It is thought that dehiscence of the levator palpebrae superioris aponeurosis from the superior tarsus lengthens the fornices, as traction from the levator pulls the conjunctiva further back. Presentation usually occurs during or after the seventh decade of life. Women are more often affected than men. Unilateral pathology is more common, though bilateral cases have been seen. Some patients may have a history of chronic nasolacrimal duct obstruction or dacryocystitis as well [14].

Symptoms include redness, pain, tearing, foreign body sensation, and discharge. Examination will reveal upper lid ptosis, deep superior fornices, coagulum of mucopurulent material in the superior fornix, injection, and mucopurulent or purulent discharge. Pseudomembranes have also been reported. With chronic, undertreated conjunctivitis, punctate epitheliopathy, corneal neovascularization, scarring, epithelial defects, and ulceration are possible. Conjunctival cultures are most often positive for *Staphylococcus aureus*, and they should be routinely obtained in these patients due to the prevalence of methicillin-resistant *S. aureus* [14].

The management and course of deep fornix syndrome can often be difficult for clinicians and patients. First-line therapy includes frequent (every 1–2 h) topical steroids and topical antibiotics as well as systemic anti-staphylococcals [14]. Prednisolone acetate 1% is often used as the steroid, though fluorometholone and loteprednol may provide similar ocular surface benefits with a lower risk of steroid-induced ocular hypertension. Sweeping of the fornices with cotton tip applicators is

recommended to debride the large coagulum from the fornices. Rinsing and sweeping the superior fornices with povidone-iodine has been reported to work in patients that did not improve with topical therapy [45]. Finally, surgical reconstruction of the fornix has also been successful in treating some patients that were refractive to more conservative measures [46].

1.10.3 Moraxella Conjunctivitis

Moraxella has been well known as a pathogen that causes angular and ulcerative blepharitis, but it should also be entertained in the differential for chronic follicular conjunctivitis. One study at a tertiary care center demonstrated 33 cases of *Moraxella* conjunctivitis over the course of a year [47]. Due to the potential for a follicular conjunctivitis, *Moraxella* has been misdiagnosed as adenovirus, herpesvirus, and *Chlamydia*. Performing Giemsa stains and obtaining conjunctival cultures prior to initiating treatment allows for quick rectification of a misdiagnosis that may have implications of a sexually transmitted infection from *Chlamydia*. Treatment can be guided by sensitivity results from microbiology.

1.11 Phlyctenular Keratoconjunctivitis

Phlyctenular keratoconjunctivitis is a type of inflammatory conjunctivitis from a hypersensitivity reaction. The triggering antigen is usually a bacterial protein usually from *Staphylococcus aureus*, but may also be from *Candida albicans*, virus, or nematode. Many patients have associated blepharitis. The diagnosis is mainly clinical. Patients have one or more small yellow-gray nodules (phlyctenules) that appear at the limbus, on the cornea, or on the bulbar conjunctiva and persist from few days to 2 weeks. The patients present with lacrimation, photophobia, and foreign body sensation when cornea is involved. Corneal lesions begin at the limbus and spread centrally, leaving no clear zone between the lesion and the limbus (Fig. 1.6).

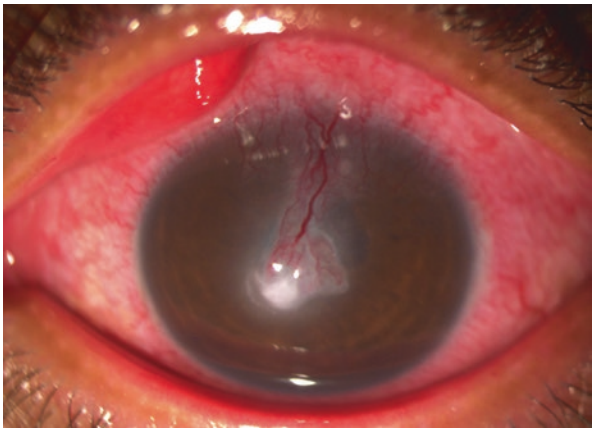

Fig. 1.6 Phlyctenular keratoconjunctivitis with leash of blood vessel. (Courtesy: Aravind Roy)

Conjunctival lesions are associated with mild symptoms, including tearing and foreign body sensation. Recurrence is known with associated blepharitis and may lead to corneal neovascularization and loss of visual acuity. Histopathologically, phlyctenules consist of subepithelial inflammatory nodules containing lymphocytes, histiocytes, neutrophils, and plasma cells.

Management requires both anti-inflammatory and antibacterial management, as well as management of chronic blepharitis. Aggressive lid hygiene with hot compresses, lid cleansers, and antibiotic drops is required to prevent disease recurrence. Topical corticosteroids should be tapered slowly to avoid recurrences. Systemic administration of tetracycline derivatives, such as doxycycline has been used to prevent recurrence. Tetracyclines should not be used in children under age 8 due to the risk of permanent tooth discoloration. It should be avoided in pregnant women and nursing mothers.

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