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An Overview of Pink Eye Inflammation and its Effect on Public Health

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***Abstract*: Conjunctivitis is characterized by inflammation of the bulbar and palpebral conjunctiva, the transparent lubricating mucous membrane covering the inside of the eyelids as well as the surface of the eye. There are numerous causes of conjunctivitis, including allergic and toxic insults, as well as infections from different bacteria, fungi, and viruses. Conjunctivitis, commonly referred to as pink eye, is a common condition that affects about 6 million people annually in the United States and accounts for 1% of all primary care office visits. Despite receiving antibiotic treatment for 80% of their cases, only about 30% of primary care patients with infectious conjunctivitis are found to have bacterial conjunctivitis. Geographical location and age are major factors in the bacterial etiology. Around the world, conjunctivitis is a common ailment seen in ophthalmology clinics. Alarming symptoms for more serious intraocular conditions, such as severe pain, decreased vision, and painful pupillary reaction, need to be taken into consideration when managing suspected cases of conjunctivitis. Furthermore, patients with atypical findings and a chronic course should have a comprehensive physical examination as well as a complete medical and ophthalmic history. Conjunctival involvement in a systemic condition may be detected by concurrent physical exam findings and pertinent history. Viral-induced conjunctivitis remains the most common cause of illness in general the second most common cause of infectious conjunctivitis is bacterial conjunctivitis however less common.**

***Keywords*: allergic, bacteria, conjunctivitis, covid-19, epidemic keratoconjunctivitis (EKC), methicillin-resistant staphylococcus aureus (MRSA) infection, pharyngeal-conjunctival fever (PCF), pink eye, inflammation, red eyes, toxic, viral infections.**

1. Introduction

The word "Conjunctivitis" refers to a broad range of conditions that are distinguished by conjunctival inflammation. Viral infections account for about 80% of cases of infectious conjunctivitis, with bacterial infections following closely behind. Allergy, mechanical/irritative/toxic, immune-mediated, and neoplastic are the noninfectious forms. Approximately 40% of Americans suffer from allergic conjunctivitis, which is the most common type of noninfectious conjunctivitis. In addition, conjunctivitis can be categorized as acute, chronic, or recurrent based on the clinical response's severity and mode of onset. Most cases of conjunctivitis caused by viruses and bacteria are classified as acute, and less often as hyperacute. The immune-mediated, mechanical, irritating, toxic, and neoplastic forms can have an acute onset, while the toxic form is usually linked to chronic inflammation [1]. Chronic allergic conjunctivitis may have a childhood onset and manifest as acute exacerbations brought on by certain seasons or situations, such as wearing contact lenses. In primary care, conjunctivitis is a ubiquitous presentation. About 2% of all medical consultations in the US are attributed to it, along with innumerable self-referrals to neighborhood pharmacies [2], [3]. Accurately capturing the true epidemiology of conjunctivitis is challenging due to the large number of patients who may choose to self-medicate, postpone, or decline seeking medical attention, as well as the prevalence of incorrect diagnoses in primary care settings. About 70% of all patients presenting to urgent care and primary care with acute red eye resulting in a significant financial and social burden [4], [5]. The significant pharmacoeconomic consequences of infectious conjunctivitis comprise missed work or school days, insurance copays, repeat diagnoses, referrals, and patient medication costs. An estimated 6 million Americans suffer from acute conjunctivitis annually, and treatment for bacterial conjunctivitis alone costs $377–857 million in the US each year [6].

To the best of our knowledge, there are no published studies on the health-related quality of life of patients suffering from acute infectious conjunctivitis. This narrative review aims to identify gaps in diagnosis and treatment and offer useful advice on distinguishing acute infectious conjunctivitis in a primary care context [7].

Bacterial conjunctivitis: An analysis of the prevalence of positive bacterial cultures in adult patients who presented their general practitioner with a red eye and either glued eyelids or a (muco)purulent discharge revealed that approximately 32% of cases of acute infectious conjunctivitis are caused by bacteria [8]. Although it usually affects one eye, bacterial conjunctivitis can occasionally affect both. Adult cases of bacterial conjunctivitis are most frequently caused by staphylococcal species, which are then followed by Haemophiles influenza and Streptococcus pneumoniae. In children, 50–75% of cases of conjunctivitis—which is frequently brought on by S—are attributed to the bacterial illness. Moraxella catarrhalis, H. influenzae, or pneumoniae. Neisseria gonorrhoeae or Chlamydia trachomatis are the two bacteria that cause the hyperacute form of bacterial conjunctivitis. Mucopurulent discharge and conjunctival redness that appear quickly are signs

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of acute bacterial conjunctivitis [8]. Less frequently, but still possible, are burning and itching as symptoms [9]. Within 7 to 10 days, acute bacterial conjunctivitis resolves on its own. Delaying the use of topical broad-spectrum antibiotics is advised, and no Antibiotics should be avoided for a while [10]. And there is no proof that any topical antibiotic agent is better than another. Resistant to methicillin, an ophthalmologist must treat Staphylococcus aureus (MRSA) conjunctivitis, which is thought to be the cause of 3–64% of ocular staphylococcal infections using antibiotics that are effective against MRSA, like besifloxacin ophthalmic suspension [10].

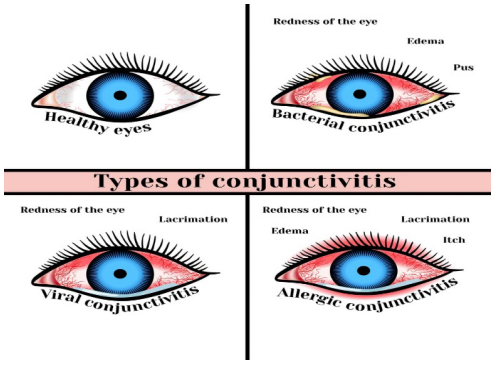

Fig. 1. Types of Conjunctivitis

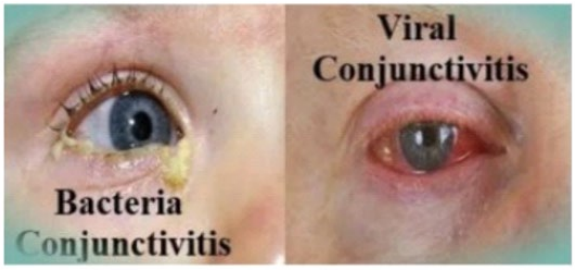

Fig. 2. Bacterial conjunctivitis

Viral conjunctivitis: Most cases of viral conjunctivitis (65–90%) are caused by adenoviruses, whereas 1.3–4.8% of cases of acute conjunctivitis are caused by the herpes simplex virus (HSV). Molluscum contagiosum varicella (herpes), and zoster virus (VZV) are additional viruses linked to conjunctivitis [11]. Non-enveloped viruses with a high degree of resistance to disinfection are known as adenoviruses [12]. Because the virus can live for several weeks at room temperature in a desiccated state, adenoviral conjunctivitis is extremely contagious [13]. There is a 10% to 50% chance of transmission; the infection can spread directly through personal contact or indirectly through shared objects. Adenoviral conjunctivitis as unilateral, but it eventually spreads to both eyes. Adenovirus serotypes have been linked to a variety of ocular infections, such as epidemic keratoconjunctivitis (EKC; patient images displayed) and pharyngeal-conjunctival fever (PCF). Usually, pharyngeal-conjunctivitis presents as a bilateral rash, fever, and enlarged periauricular lymph nodes. EKC is more severe due to its potential to negatively impact visual acuity; it is characterized by the involvement of lymph nodes on both sides of the neck, watery discharge, swelling, and redness. EKC is extremely contagious, and individuals who have the illness but show no symptoms may unintentionally transmit the virus [14].

Pseudo membrane formation on the palpebral conjunctiva in both the early and late stages of the condition is a complication of EKC. In cases of severe inflammation, manual removal of these membranes may prevent symblepharon formation and cause mild bleeding without harming the underlying epithelium [15]. In the cornea, multifocal subepithelial infiltrates can appear 7–10 days after the first clinical indications of an infection [16]. In certain situations, these may continue for weeks or even years. Subepithelial infiltrates have the potential to scar the cornea and result in irregular astigmatism and loss of visual acuity if treatment is not received [17]. When recovering from an adenoviral infection, corticosteroids should be used cautiously, particularly in the later stages of treatment [18]. Note that chlamydial conjunctivitis can also present with subepithelial infiltrates. Given that viral shedding persists after onset and that there are currently no approved medications for adenoviral conjunctivitis, the mainstay of treatment for the condition is supportive care (cold compresses, chilled artificial tears along with guidance on infection control [19].

Fig. 3. Adenoviral bacterial conjunctivitis [16]

Allergic conjunctivitis: Seasonal allergies are the primary cause of allergic conjunctivitis, which typically manifests as bilateral symptoms. The main symptoms of allergic conjunctivitis, which can also present with a mucous or watery discharge, are redness and mild to severe itching. Treatment consists of topical or oral antihistamines, mast cell inhibitors, and supportive measures (cold compress, artificial tears). When corneal involvement and herpetic infection have been ruled out, a brief course of topical corticosteroids may be used; however, the use of steroids may exacerbate both conditions [11].

2. Etiology

The most typical reasons for pink eye, or conjunctivitis, are bacteria, viruses, and allergies. Additional reasons consist of substances wearing contact lenses, foreign objects in the eyes (such as a loose eyelash) air pollution, both indoors and outdoors, things like smoke, dust, fumes, or chemical vapors, Ameba fungi and parasites. Conjunctivitis can have a variety of causes, some of which can have similar symptoms, making it challenging to identify the precise cause [19].

Viral infection resulting in eye inflammation may result from a variety of viruses, including adenoviruses extremely

contagious.

An eye infection brought on by specific bacteria can be Moraxella catarrhalis, Haemophilus influenzae, Streptococcus pneumoniae, Staphylococcus aureus, or, less frequently, Neisseria gonorrhoeae and Chlamydia trachomatis, easily spread, particularly when combined with specific bacteria and in specific environments. Kids with conjunctivitis who don't have a fever or exhibit altered behavior can typically still attend school. More typical in children than in adults and more often observed From December to April [20]. In otherwise healthy people, bacterial conjunctivitis most frequently manifests itself. Exposure to infected individuals, contact lens wear, sinusitis, immunodeficiency states, prior ocular disease, trauma, and exposure to agents of sexually transmitted diseases at birth are risk factors. Fomite contact includes touching objects such as towels, napkins, pillowcases, slit-lamp chin rests, and handles Since wearing contact lenses is so common, special consideration should be given to them [21]. It is well known that wearing contact lenses—especially while sleeping—increases the risk of developing bacterial corneal infections, particularly in developed nations where contact lens use Is more common. In addition, contact lens wearers who neglect to properly maintain contact lens integrity and contact lens case hygiene run a higher risk of developing a bacterial corneal infection [22].

Fig. 4. Allergic conjunctivitis [18]

The body's response to allergens, which include dust mites, molds, pet dander, medications, cosmetics, and pollen from trees, plants, grasses, and weeds. Not transmissible, more commonly in those who have other allergic conditions like eczema, asthma, or hay fever can happen periodically when allergens like pollen concentrations are high and can also happen all year round as a result of indoor allergens [6].

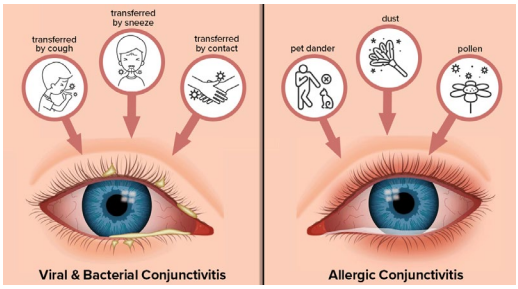

Fig. 5. Etiology of conjunctivitis

3. Symptoms

The color of either pink or red in the eye(s) whites, swelling of the eyelids and/or conjunctiva, the thin layer lining the inside of the eyelid, and the white portion of the eye.

An increase in the number of tears shed, having the urge to rub one or more eyes, or feeling as though something foreign is in them Burning, irritability, or itching Release (mucus or pus) lashes or eyelids being crusted, particularly in the morning, contact lenses that are uncomfortable to wear or that move around in the eye. There may be additional symptoms, depending on the cause [23].

4. Pathophysiology

Common flora like streptococci, staphylococci, and corynebacteria colonise the surface tissues of the eye and the ocula adnexa [24]. Clinical infection can result from changes in the bacterial species, bacterial titer, or host defence. The flora may also change as a result of external contamination (such as swimming or wearing contact lenses), topical or systemic antibiotic use, or transmission from nearby infectious sites (such as rubbing of the eyes) [25]. The conjunctiva's epithelium layer serves as the body's main line of defence against infection. Infection may result from this barrier's disruption. Hematologic immune mechanisms transported by the conjunctival vasculature, tear film immunoglobulins, lysozyme, and the rinsing effects of lacrimation and blinking are examples of secondary defences [26].

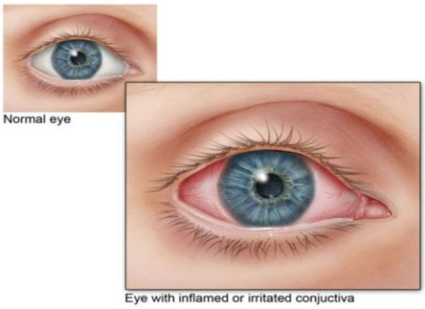

Fig. 6. Eye with inflamed conjunctivitis [21]

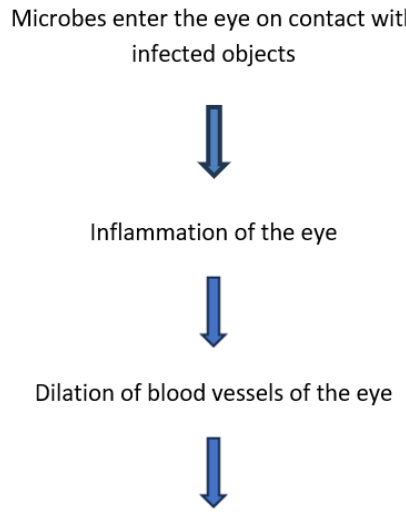

Fig. 7. Pathophysiology of conjunctivitis

5. Epidemiology

All over the world, bacterial conjunctivitis is common. According to estimates, there are 135 cases of bacterial conjunctivitis for every 10,000 people in the US each year which accounts for about 1% of primary care consultations [27]. Globally, isolated epidemics can be disastrous in regions where neonatal infections cause blindness, particularly in regions where C trachomatis is a major problem [28]. Which can result in blindness in as many as 8% of the population. The most frequent cause in Paraguay Thailand, India is streptococci, followed by staphylococcal infection [29], [30]. A bimodal age distribution, a springtime surge in cases that is predicted, and a greater incidence in adult women than in men. Seasonality was a constant in conjunctivitis. Since atopic conjunctivitis diagnosed in the ED peaked over this period, increases in allergic conjunctivitis could account for this observation; this argument, however, is purely theoretical. Although studies examining the seasonality of related infectious agents, such as those causing otitis media and viral infections in children, showed peaks in the winter months, bacterial or viral conjunctivitis may also be a factor in the rise in occurrences

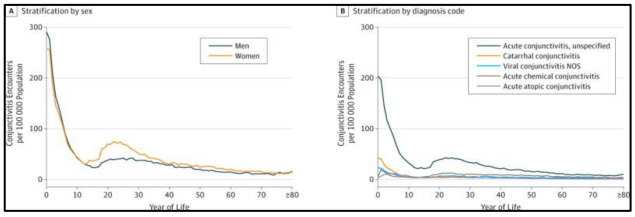

Fig. 7. Age-Incidence curve for acute conjunctivitis diagnosed at US emergency departments

Cases were calculated using the total number of cases at each year of age divided by the total census population for that same age, with the mean calculated from January 1, 2010, through December 31, 2013. NOS indicates not otherwise specified.

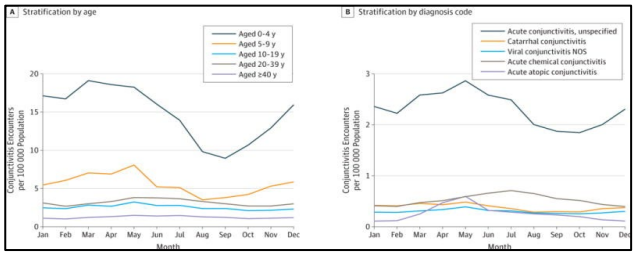

Fig. 8. Seasonality of acute conjunctivitis by age group in US emergency departments

Cases were calculated using the total number of cases in each month divided by the total census population for that same month, with the mean calculated from January 1, 2010, through December 31, 2013. NOS indicates not otherwise specified [31].

6. Prognosis

As long as the cornea is not affected, there is a good chance of full recovery from bacterial conjunctivitis without any after effects. Topical antibiotics or self-healing are used to treat the majority of benign cases. Without treatment, bacterial conjunctivitis usually goes away in 1-2 weeks. Only situations involving extremely pathogenic bacteria, like C trachomatis or N gonorrhoeae, are anticipated to result in complications [32].

The inability to identify and treat the underlying condition is a contributing factor to mortality in the context of bacterial conjunctivitis. Meningitis and sepsis brought on by N gonorrhea have the potential to be fatal. A newborn with a chlamydial infection may develop otitis media or pneumonia [33]. In benign cases, discomfort, mucopurulent ocular discharge, and conjunctival redness are typical signs and symptoms that frequently result in absence from [34].

7. Diagnosis

Based on the patient's medical history, symptoms, and ocular examination, a physician can typically identify whether a virus, bacteria, or allergy is the cause of conjunctivitis, or pink eye. Although eye redness or swelling is a common symptom of conjunctivitis, there are other symptoms as well that can change based on the underlying cause [35].

It can occasionally be challenging to identify the cause without conducting laboratory testing. To assist them in determining which form of infection is present, your healthcare provider may occasionally take a sample of the discharge from the affected eye and send it to a laboratory [36].

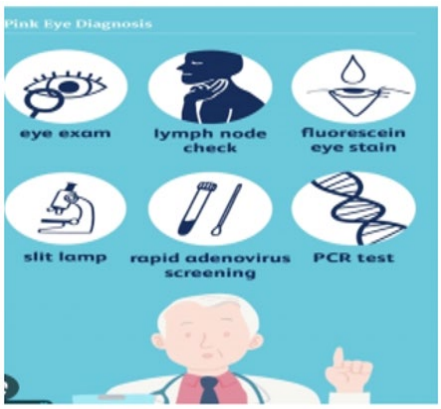

Fig. 9. Pink eye diagnosis

8. Treatment

There are instances in which getting medical attention for conjunctivitis (pink eye) is crucial. This isn't always required, though [37] conjunctivitis usually clears up on its own without any medical intervention. A doctor may advise using over-the-counter medications to treat the symptoms if they are severe and prolonged.

If a person experience any of the following symptoms in addition to conjunctivitis, they should consult a doctor about:

- Sensitivity to light
- Pain in the affected eye(s)
- Blurred vision [37]

If a doctor suspects a bacterial illness in the patient, they may recommend antibiotics. Some doctors will prescribe antibiotic eye drops or other medications from Trusted Source as a precaution, though there's no assurance they'll help. For

bacterial conjunctivitis, antibiotics such as levofloxacin, besifloxacin, moxifloxacin, and fluoroquinolones are usually helpful. For acute conjunctivitis, erythromycin ointment, sulfacetamide drops, or polymyxin/trimethoprim drops (Polytrim) are the first-choice broad-spectrum topical antibiotics. Chlamydial conjunctivitis can be effectively treated with oral medicines like doxycycline or azithromycin. Oral ciprofloxacin, however, Gentamicin (Garamycin), ciprofloxacin (Ciloxan), tobramycin (Tobrex), bacitracin (Ocutracin), moxifloxacin (Vigamox), gatifloxacin (Zymar), azithromycin (Azasite), and ofloxacin ophthalmic (Ocuflox) are a few of the antibiotic drops that are used to treat bacterial eye infections [38], [39].

Antibiotics cannot be used to treat a viral illness. Topical antiviral medications, such as ganciclovir (Zirgan), idoxuridine solution and ointment, vidarabine ointment, and trifluridine solution (Viroptic), are typically used to treat patients with HSV-caused conjunctivitis. Until the skin lesion is addressed, conjunctivitis linked to molluscum contagiosum will continue to worsen. Usually, the infection can be cured by removing the lesion's central core or by causing bleeding to occur inside the lesion.To stop viral replication, high-dose oral acyclovir is part of the treatment for VZV eye illness.

Many varieties of topical drops are available for the treatment of allergic conjunctivitis. Notably, stopping the prolonged use of vasoconstrictive medications might cause rebound vasodilation.

Vasoconstrictors: First line is inexpensive over-the-counter. There are numerous brands that contain phenylephrine 0.12%, oxymetazoline HCl, tetrahydrozoline HCl, naphazoline HCl, or antazoline phosphate 0.05%. Antagonists of the H-1 receptor: Far more costly than vasoconstrictors, but far more effective. The three main options are levocabastine HCl 0.05% (Livostin), emedastine (Emadine), and pheniramine maleate 0.3% (Naphcon). You can utilize stabilizers for mast cells. Mast cell stabilizers: lodoxamide tromethamine 0.1% (Alomide), nedocromil 2% (Alocril), cromolyn sodium 4% (Crolom), and pemirolast 0.1% (Alamast). Only vernal conjunctivitis is specifically covered by FDA approval for these. Use only after all other medicine classes have been exhausted. The following combinations of H-1 receptor antagonist and mast cell stabilizers can also be used: optivar, ketotifen fumarate (Zaditor, Alaway), olopatadine hydrochloride 0.1% (Patanol), olopatadine hydrochloride 0.2% (Pataday), and Elestat. When compared to mast cell stabilizers alone, these medicines are more effective [40].

A quick course of topical corticosteroids with low potency and low frequency should be used if symptoms are not sufficiently controlled. FDA-approved NSAIDs, such ketorolac, are typically used as adjuvant treatments for seasonal allergic conjunctivitis. Anti-inflammatory non-steroidal drugs: 0.5% tromethamine (ketoralac) (Acular). Oral antihistamines can be utilized, particularly if the patient is exhibiting additional systemic effects. Examples of such medications are Xyzal (levocetirizine), Zyrtec (cetirizine), Allegra (fexofenadine), Clarinex (desloratadine), and Clarinex (loratadine).

9. Management

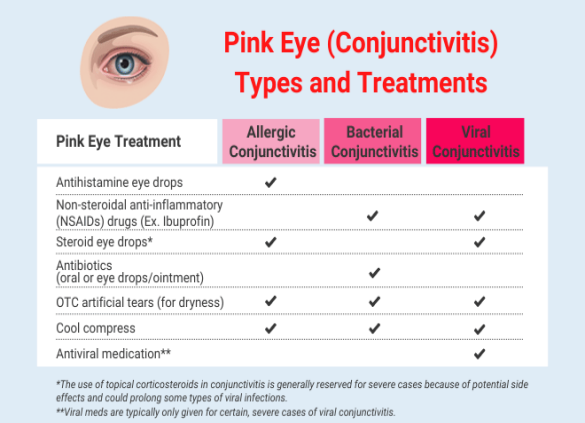

Fig. 10. Treatment of conjunctivitis

Some additional measures can be used as adjunctive measures to improve symptom management are as follows:

- Prescription-free artificial tears help to reduce dryness
- Warm compresses help to reduce the sticky buildup of discharge on the eyelids or crust that forms on your eyelashes.
- Cold compresses help to relieve itching and inflammation.
- The person should also make an effort to stay away from the substance causing the reaction if it is related to an allergy or irritant.
- Frequent clothes washing and bathing/showering before bedtime.
- Refer/consult allergy or dermatology for those who are not adequately controlled with topical medications and oral antihistamines.
- The patient is ought to cease wearing contact lenses until their ophthalmologist gives the all-clear.

10. Prevention

Individuals can reduce their chance of getting infective conjunctivitis or spreading it by,

- Avoiding rubbing or touching the eyes
- Hand sanitizing or frequently washing hands
- Always taking out contact lenses at night and adhering to all lens hygiene instructions
- Maintaining clean spectacles
- Not sharing personal goods like towels and makeup.
- Putting on goggles while in the pool.
- Avoiding swimming when under infection
- Ensuring that rooms are adequately ventilated
- Keeping air conditioning units clean and maintained, and avoiding smoke-filled environments [41].

11. Conclusion

A frequent complaint in the paediatric primary care office is conjunctivitis. A physician can ascertain the most likely aetiology with the aid of diagnostic hints gleaned from the patient's history and examination. Most paediatric cases of

conjunctivitis are caused by bacteria and typically manifest as mattering of the eyes and purulent discharge. In addition to producing a watery discharge and a gritty feeling, viral conjunctivitis is frequently accompanied by other upper respiratory symptoms. Usually, bilateral, allergic conjunctivitis is correlated with seasonal allergen levels. Certain populations are more susceptible to secondary causes of conjunctivitis, such as people who wear contact lenses, live in highly polluted areas, or have symptoms that are not limited to conjunctivitis. Most cases are treated with topical lubricants in a supportive capacity; however, antibiotics may be necessary in certain circumstances.

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