Clearing the blur: a microbial menace in focus – understanding bacterial conjunctivitis

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Abstract

Bacterial conjunctivitis (BC), colloquially known as "pink eye", typically presents with redness, purulent discharge (sticky eyelids), itching, and a foreign body sensation in the eye. The common pathogens that cause the condition are *Staphylococcus aureus*, *Streptococcus pneumoniae*, *Haemophilus influenzae*, and *Moraxella catarrhalis*. Presentation of the condition can be acute or chronic, depending on the duration of the symptoms. Although BC is self-limiting, antibiotic treatment in the form of an eye drop or ointment is sometimes prescribed to reduce discomfort. BC is a contagious infection, and hand hygiene should be encouraged to reduce the risk of transmission.

Keywords: bacterial conjunctivitis, pink eye

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Introduction

The conjunctiva is a thin, translucent membrane found inside the eyelid and the anterior part of the sclera. Inflammation of the conjunctiva can lead to itching, pain, swelling, and discharge, which may be purulent, serous, or mucopurulent. This condition is commonly known as conjunctivitis or "pink eye".[1,2] Inflammation may result from immunological reactions, infection (viral, bacterial, or parasitic), allergic or mechanical irritation, neoplasia, or toxic substances.[3-5] In addition to aetiology, conjunctivitis can also be classified based on chronicity, severity, and the extent of involvement of the surrounding tissue.[1]

Conjunctivitis poses an immense economic burden within the healthcare system and is one of the leading reasons for medical or ophthalmological visits.[1,6,7] In the United States of America, approximately 2% of medical visits are due to conjunctivitis, and BC costs the country approximately $857 million annually. It can affect a person at any age, demographic, or socio-economic status.[1,6] Viral and bacterial conjunctivitis (BC) can become contagious, with BC epidemics being most prevalent in winter and early spring.[7] This article aims to provide insight into the causes of BC and the appropriate treatment.

Causes

BC is most often caused by the bacteria *Staphylococcus aureus*, *Streptococcus pneumoniae*, *Haemophilus influenzae*, and *Moraxella catarrhalis*. Among these pathogens, *Staphylococcus aureus* is more prevalent in adults, while the other pathogens are more commonly found in children.[8,9]

Gram-positive organisms are responsible for most ophthalmic infections, whilst Gram-negative organisms are more likely to be the causative agents in contact lens wearers.[10] Gram stains and conjunctival cultures are the gold standards for identifying pathogens; however, in some instances, the nature of the conjunctivitis can suggest the pathogen. For example, *Neisseria gonorrhoeae* is usually found in hyperacute purulent conjunctivitis, while *Staphylococcus aureus* is found in patients with chronic conjunctivitis.[11] Additionally, severe bacterial infections that are linked to sexually transmitted infections can often lead to complications if left untreated. Incidentally, *Neisseria gonorrhoeae* tend to progress rapidly to corneal perforation, while chlamydia can also cause chronic conjunctivitis.[8]

Newborn infants face a heightened risk of developing BC within the first 28 days of life. This condition is known as ophthalmia neonatorum (ON) because of vertical transfer through an infected birth canal during the delivery process. ON caused by gonorrhoea typically manifests within the initial five days after birth but can extend up to three weeks, while chlamydia-related ON usually presents between five and 14 days after birth.[12]

Immunocompromised individuals, such as those with human immunodeficiency virus (HIV) or transplant recipients taking specific immunosuppressive medications, may have an elevated susceptibility to BC.[13]

Risk factors

Potential risk factors for BC include conditions such as dry eye, defective tear film, systemic immunosuppression, prior infections, ocular trauma, and a history of hospitalisation or eye cosmetic application.[11] Moreover, air pollution has been increasingly recognised as an important risk factor for conjunctivitis.[14]

Signs and symptoms

The clinical presentation of BC can aid in its diagnosis. Common early symptoms include bilateral symptoms, redness, discharge,

Table I: Common conjunctivitis pathogens and associated signs and symptoms[11,15]

Bacteria	Area affected	Presentation	Points to note
Staphylococcus *Staphylococcus aureus* Most common pathogen of adult BC	Papillary conjunctivitis Affects the bulbar	Acute BC Mucoid or mucopurulent Matting and sticky closure of the eyelashes Can become chronic conjunctivitis if there is associated blepharitis	The purulence is due to dead tissue, degenerated white blood cells, and bacteria
Streptococcus *Streptococcus pneumoniae* Occurs in temperate climates in winter and is often seen in children	Papillary	Acute Mucopurulent discharge Papillary reaction	
Haemophilus *Haemophilus influenzae* Most common cause in children		Two forms: 1. Encapsulated form presents with mucoid or mucopurulent conjunctivitis, which is highly contagious 2. Non-encapsulated form seen in springtime and associated with upper respiratory tract infections It is self-limiting and resolves within 1–2 weeks of onset	Children with concurrent otitis and conjunctivitis are more likely to have *Haemophilus* conjunctivitis
Neisseria *Neisseria gonorrhoeae*		Hyperacute, profuse, purulent conjunctivitis with chemosis, eyelid swelling, and keratitis Urethral symptoms precede the ocular symptoms by several weeks	If untreated, gonococcal conjunctivitis can result in corneal perforation within 24 hours
Chlamydia *Chlamydia trachomatis* Serovars A–C are associated with trachoma	Follicular conjunctivitis	Mucoid discharge and hyperaemia Classified as chronic conjunctivitis	Serovars A–C are the leading cause of preventable blindness
Moraxella *Moraxella catarrhalis*		Causes chronic conjunctivitis and is often associated with angular blepharitis	Can be misdiagnosed as adenovirus, chlamydia, or herpes virus

itching, and a foreign body sensation in the eye. One of the most common complaints is feeling that the eyelids are "stuck together" early in the morning.

BC usually peaks within 2–3 days after the onset of symptoms and generally resolves within two weeks. Chronic conjunctivitis typically lasts longer than four weeks, while acute conjunctivitis has an onset of less than four weeks. Complications may include corneal ulceration, corneal perforation, xerosis (dry eye), and preseptal cellulitis.[11] Table I describes the pathogens and associated signs and symptoms.

History[2]

Accurately identifying the nature of a condition, whether infectious or not, requires taking a careful patient history. The pharmacist, therefore, must enquire about:

- the duration of the symptoms (hyperacute, acute, or chronic);
- a description of the discharge (purulent or mucopurulent);
- associated symptoms (pain, itching, photophobia, or vision loss);
- possible trauma; previous similar episodes; prior treatment; contact lens use; immune status; sexual history; and
- the presence of otitis media, as BC can present with optic symptoms.

Treatment

Antibiotic resistance is a growing concern in treating bacterial infections, including BC.[16] While BC is generally self-limiting, treatment is recommended to reduce discomfort. Eye ointments tend to last longer; however, they can impair vision. Consequently, drops are the preferred route of administration. Table II provides the recommended treatment for BC.

Besifloxacin has been identified as an effective option for treating BC, showing efficacy against various bacterial species commonly implicated in the infection.[17,18] Studies have compared the efficacy of different antibiotics in treating BC, demonstrating the clinical and microbiological efficacy of medications like lomefloxacin and tobramycin.[18]

New treatment developments

Research has also focused on identifying biomarkers to differentiate bacterial from non-bacterial infections, aiding in accurately diagnosing and treating conditions like BC.[11,19] Moreover, strategies targeting bacterial biofilms, such as those discussed in combating bacterial biofilms, could be valuable in managing chronic or recurrent cases of BC.[20]Alternative therapies, including phage therapy, have emerged as potential options to address antibiotic-resistant bacterial infections.[21] Phage cocktails have been recognised as a strategy to limit the emergence of phage resistance in bacterial targets.[22] Furthermore, using bacteriophages as biocontrol agents presents a promising avenue for sustainable agriculture and could be adapted for ocular infections.[23]

Innovative delivery systems, such as liposomes, have been explored to combat antimicrobial resistance and enhance

Table II: Recommended treatment for BC[8,5]

Type of conjunctivitis	Treatment	Dosage
Moderate to severe BC	Aminoglycosides: • tobramycin • neomycin	Use every 4 hours Use ointment every 8 hours for 7 days
	Bacitracin/polymyxin B ointment	Every 3–4 hours for 7–10 days
	Chloramphenicol 1% ointment Chloramphenicol 0.5% drops	Every 8 hours for 5 days Every 2–4 hours for 5 days
	Fluoroquinolones: • ciprofloxacin • ofloxacin • levofloxacin • moxifloxacin • gatifloxacin • besifloxacin	Every 4 hours for 2 days, then every 6 hours for 5 days
	Fusidic acid 1% drops	Twice daily until it resolves
Gonococcal conjunctivitis	Ceftriaxone 1 g intramuscular	Once
Chlamydial infection	Azithromycin 1 g orally	Once
	Doxycycline 100 mg orally	Twice daily for 7 days

Note:
- The latest generation fluoroquinolones provide both strong Gram-negative and some Gram-positive coverage.
- Bacitracin, erythromycin, and ciprofloxacin can be administered as an ointment.
- Fluoroquinolones are ideal for contact lens wearers for empiric *Pseudomonas* coverage.

the efficacy of antibiotics.[24] Functionalising nanoparticles for enhanced penetration through biofilm matrices could improve the targeting of bacterial cells within biofilms, offering a potential solution for persistent infections.[25] Additionally, the use of cationic antimicrobial peptides in combination with histone deacetylase inhibitors has shown promise in enhancing antimicrobial activity against bacteria.[26] Also, advancements in drug delivery systems, such as intravitreal implants releasing antibiotics like ciprofloxacin, have shown promise in treating bacterial infections in the eye, including conjunctivitis.[27]

Non-pharmacological interventions

BC is easily spread through direct contact, and educating patients on prevention methods remains the best way to reduce the risk of transmission. A study found that approximately 46% of patients had positive cultures when their hands were swabbed, proving that hand hygiene remains fundamental in reducing the transmission of BC.

If infected with BC, simple measures such as avoiding swimming pools, shaking hands, touching eyes, and sharing personal items should be practised.[5] Non-pharmacological treatments may include applying warm compresses to the eyes to alleviate discomfort and reduce inflammation and practising proper eye hygiene, such as regularly cleaning the eyelids with a warm, gentle soapy solution.[28]

Conclusion

BC is a common complaint that accounts for numerous doctor visits. While it is often a self-limiting condition, antibacterial treatment can help reduce the discomfort. Topical antibacterial ointments and drops are usually the first-line treatments, but advising the patient on proper hand-washing techniques and eye hygiene is instrumental in preventing transmission.

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