

# Bacterial Keratitis

Bacterial keratitis is also often referred to as a 'corneal ulcer'. In practice, these terms are not directly interchangeable because a cornea may harbor a bacterial infection (i.e bacterial keratitis) without having a loss of tissue (an ulcer) and a cornea may have an ulcer without a bacterial infection.

Bacterial keratitis is a serious bacterial infection of the cornea which can, in severe cases, cause loss of vision.

## Etiology

Although infectious ulcers may also be due to fungi, viruses, mycobacteria and protozoa, bacteria are the most common cause of infectious keratitis.

## Risk Factors

Risk factors for bacterial keratitis are those that cause disruption of the integrity of the corneal epithelium. The most common risk factor for bacterial keratitis is contact lens wear. Contact lens wear has been associated with 19%-42% of cases of culture proven corneal infections. Overnight wear and inadequate lens disinfection have been associated with increased risk of infection. Other predisposing factors include: trauma (including foreign bodies and chemical and thermal injuries), contaminated ocular solutions, changes in the corneal surface (from dry eye, eyelid misdirection, and exposure), altered ocular defense mechanisms (from topical and systemic immune suppression), loose sutures with adjacent infections (blepharitis and viral keratitis), and corneal edema. In younger patients, trauma and contact lens wear are the most common predisposing factors while in older patients, chronic corneal disease such as dry eyes, surgical trauma, and bullous keratopathy are also important risk factors.

## General Pathology

Bacterial keratitis can advance through four stages: progressive infiltration, active ulceration, regression, and healing.

## Pathophysiology

Corneal infections rarely occur in the normal eye. They are a result of an alteration in the cornea's defense mechanisms that allow bacteria to invade when an epithelial defect is present. The organisms may come from the tear film or as a contaminant from foreign bodies, contact lenses or irrigating solutions. The severity of the disease depends on the strain of the organism, the size of the inoculum, the susceptibility of the host and immune response, the antecedent therapy, and the duration of the infection. The process of corneal destruction can take place rapidly (within 24hrs with virulent organisms) so that rapid recognition and initiation of treatment is imperative to prevent visual loss.

## Primary prevention

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Avoidance of predisposing factors may reduce the risk of corneal infection. Proper education of contact lens use and care can help decrease the risk. The use of protective eyewear for sports and outdoor activities can help prevent trauma and the subsequent development of infection.

## Diagnosis

A diagnosis of bacterial keratitis should include a detailed history and a complete ophthalmic examination.

## History

A detailed history is as important as the examination. Physicians should take a detailed history and ask about the characteristics and onset of symptoms, whether there was recent trauma to the eye, and whether the patient engaged in activities such as swimming in contact lenses. Patients should be asked about contact lens wear (including type of lens used, time since last change to a new pair of lenses, hours of continuous wear, and cleaning regimen). A past ocular history should include whether there was a history of eye trauma, previous eye diseases, or eye surgeries. A past medical history, a list of medications and eye drops, a documentation of allergies, a pertinent family history, and a review of systems should be obtained.

## Physical examination

A complete examination including vision, intraocular pressure, pupil assessment, and slit-lamp examination should be initiated. Fluorescein can be used to highlight areas of epithelial cell loss. The ophthalmologist should document the location, size and depth of the corneal infiltrate. Any anterior chamber reaction (cells, flare, fibrin, or hypopyon), should be recorded. Patients should be dilated and possible posterior pole involvement should be ruled out. The ophthalmologist should also look for problems such as foreign bodies, blepharitis, entropion, trichiasis, or lagophthalmos, which may have predisposed the patient to infection. Both eyes should always be examined.

## Signs

Signs of bacterial keratitis might include conjunctival injection and focal white infiltrates (with epithelial demarcation and underlying stromal inflammation). Other signs can include: corneal thinning, stromal edema, endothelial inflammatory plaque, Descemet's folds, mucopurulent discharge, anterior chamber reaction and hypopyon. Eyelid edema may be present in some cases. In severe cases, posterior synechiae, hyphema, and glaucoma may occur.

## Symptoms

Symptoms include rapid onset of ocular pain, redness, photophobia, discharge, and decreased vision. The rate of progression of the symptoms is related to the virulence of the infecting organism.

## Clinical diagnosis

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Diagnosis is based on clinical history and slit lamp examination showing the presence of a corneal infiltrate.

## Diagnostic procedures

Corneal scrapings for smears and cultures are performed to determine the causative organism in all ulcers that are either large, involve the middle to deep stroma, are sight threatening, are chronic in nature, are atypical, or are unresponsive to treatment. Small infiltrates that do not stain may sometimes be treated with broad spectrum antibiotics without scraping.

## Laboratory test

Culture of all ulcers should be considered before initiating treatment with antimicrobial therapy. Gram and Giemsa staining of corneal smears are helpful to confirm the presence of microorganisms and to distinguish bacterial ulcers from fungal ulcers. Cultures might also provide helpful information about an organism's sensitivity to antibiotics.

## Differential diagnosis

The differential diagnosis of bacterial keratitis is large. Other infectious etiologies must be considered. Non-infectious (or sterile) ulcers may be related to dry eye syndrome, exposure or neurotrophic keratopathy, autoimmune diseases (such as rheumatoid arthritis), vernal keratoconjunctivitis, vitamin A deficiency, and staphylococcal hypersensitivity. Round, white scars from old foreign bodies may be confused with small infiltrates.

## General treatment

Contact lenses should be discontinued. Topical antibiotic drops should be prescribed. Oral antibiotics may be considered for patients with deep ulcers or scleral involvement. Oral medication can be used, as needed, for pain.

## Medical therapy

Topical broad spectrum antibiotic therapy should be used until culture results are available. Treatment may be selected according to the risk of potential visual loss. Small non-staining peripheral ulcers may be started on fluoroquinolone drops every 2 to 6 hours. For ulcers with epithelial defects and an anterior chamber reaction, a fluoroquinolone drop every hour around the clock is recommended. Large or vision threatening ulcers (with moderate to severe anterior chamber reaction and/or involving the visual axis) are usually treated with fortified tobramycin or gentamicin (15mg/ml) every hour around the clock alternating with fortified vancomycin (25mg/ml) every hour around the clock.

## Medical follow up

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Daily follow up is needed until a response to antibiotic regimen is noted. On follow up, assess the size of the epithelial defect, the size and depth of the infiltrate, the degree of pain and the anterior chamber reaction. Taper the antibiotics when ulcer improves. If the ulcer worsens or does not improve, consider culturing again, adding fortified antibiotics (e.g., vancomycin and tobramycin), subconjunctival antibiotics. Consider a corneal biopsy if the ulcer does not improve. In severe non-responding ulcers hospitalization for frequent monitoring and drop administration may be required. Admission may be needed if there is scleral extension or corneal perforation and systemic antibiotics and/or surgery are needed; the patient is unable to instill the medication as prescribed, he is unable to return for follow up or is noncompliant.

## Surgery

A corneal transplant or patch graft is considered for impending or actual perforations.

## Surgical follow up

When a corneal transplant is indicated, close postoperative follow-up is recommended. The cornea surgeon should evaluate for recurrence of the infection in the graft as well as graft failure and other possible postoperative complications.

## Complications

Potential complications include scleral extension of the infection, residual corneal scarring, irregular astigmatism, loss of vision, corneal perforation, and endophthalmitis .

## Prognosis

The prognosis depends on the size, location, depth, and etiology of the corneal ulcer as well as any pre-existing ocular conditions.

## Additional Resources

- Turbert D, Pagan-Duran B. Bacterial Keratitis. American Academy of Ophthalmology. EyeSmart® Eye health. <https://www.aao.org/eye-health/diseases/bacterial-keratitis-27>. Accessed March 07, 2019.
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## References

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2. External Disease and Cornea, Section 8. Basic and Clinical Science Course, AAO, 2006.
3. The Wills Eye Manual, 4th Edition. Kunimoto, Kanitkar, & Makar. Lippincott, 2004.

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