

INFECTIONS OF THE EYE

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ABSTRACT

Infections of the eye range from the mild to the severe. They may affect the lid, conjunctiva, cornea, lacrimal apparatus, vitreous, orbit or retina. Common presentations, diagnostic methods and treatment are briefly described. The doctor should not only manage outpatients appropriately, but know when to seek the advice of the ophthalmologist when indicated. Common conditions which can be managed by the general practitioner include blepharitis, styes, chalazia and conjunctivitis. With increased use of contact lenses, infection of the cornea has become more common. Sight-threatening conditions like endophthalmitis and orbital cellulitis should be recognised and treated early.

Keywords: eye, infections

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Infections of the eye range from self-limiting conditions like viral conjunctivitis to sight-threatening conditions like endophthalmitis. It is important for doctors to recognise common eye conditions and manage them appropriately as well as to be alert to those situations where referral to an ophthalmologist is necessary.

INFECTIONS OF THE EYELID

Blepharitis

This affects the lid margins and manifests with hyperaemia and thickening of the lid margins with dry flakes or oily secretions. It commonly presents as a chronic conjunctivitis with recurrent epithelial keratitis. Symptoms of photophobia, pain, grittiness, tearing, redness and discharge are characteristic. The abnormal skin predisposes to colonisation with *staphylococci* and other bacteria⁽¹⁾.

The mainstay of treatment is daily lid hygiene. Seborrhoeic flake and oil can be removed by scrubbing the lid margin with a mild shampoo (eg "baby shampoo") at least once daily. A suitable antibiotic ointment is then applied to the base of the eyelashes at night. Treatment should be continued for at least six weeks. In some instances, systemic antibiotics like oral tetracycline may be necessary to control the symptoms. Tear supplements should also be prescribed as the stability of the tear film is compromised by eyelid seborrhoea.

Styes

External styes are relatively innocuous. They present as a tender inflamed swelling at the lid margin. The glands of Zeiss which

lie adjacent to the hair follicles are involved. The natural course is for the pus to point and rupture. Removal of the affected hair follicle hastens its resolution. Topical antibiotics may be applied.

Internal styes affect the meibomian glands. This presents as a small inflamed swelling with the tarsal plate and is caused by staphylococcal infection of the meibomian glands. As these glands are more deeply situated, surgical drainage is often required. Patients with recurrent styes and infected chalazion have an underlying blepharitis which should be treated to prevent further recurrences.

Viral lid infections

Vesicular eruptions may be due to herpes simplex virus or varicella-zoster virus. Usually, these two viral lesions may be distinguished on the basis of the distribution of the lesions. Herpes simplex lesions involve the periocular area while ophthalmic herpes zoster lesions follow the dermatomal distribution of the ophthalmic branch of the trigeminal nerve. Oral acyclovir, given early, may shorten the course of the disease. Topical acyclovir is not useful. Referral to the ophthalmologist to exclude ocular involvement is necessary.

CONJUNCTIVAL INFECTIONS

Bacterial conjunctivitis

This presents with conjunctival hyperaemia, especially in the fornices and a mucopurulent discharge. Subconjunctival haemorrhages may be seen in pneumococcal or *haemophilus influenzae* conjunctivitis. Antibiotic drops (eg chloramphenicol) should be given. At bedtime, an ointment preparation would ensure a more persistent antimicrobial concentration in the conjunctiva.

Gonococcal conjunctivitis

This form of bacterial conjunctivitis deserves special mention because if left untreated, particularly in neonates, necrosis and perforation of the cornea may occur. In adults, it is due to sexual contact. In neonates, it is due to transmission from the mother during vaginal delivery, and presents 2-5 days after birth. The typical manifestation is that of a copious purulent discharge.

A Gram stain of the pus shows numerous polymorphs with intracellular gram-negative diplococci. Culture confirmation should always be sought by direct plating onto chocolate or Thayer-Martin agar. In the appropriate clinical context, treatment for presumed gonococcal infection should be urgently started.

Treatment is with parenteral ceftriaxone, 1g/d for adults or

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25-50mg/kg/d for neonates for 1-3 days and saline irrigation of the eye as frequently as possible. Topical treatment is adjunctive at best – penicillin eye drops are not useful as penicillin resistance is high in Singapore; kanamycin eye drops may be considered^(2,3).

A conjunctival scraping should be sent for immunofluorescence and culture to detect concurrent chlamydial infection, and investigation for other sexually-transmitted diseases (eg VDRL) should be done⁽⁴⁾.

Chlamydial conjunctivitis

Chlamydia causes two types of eye infections. Trachoma, caused by serotypes A, B and C, is the leading cause of blindness in the developing world and spreads through direct contact and fomites. Repeated infection leads to conjunctival scarring, entropion, trichiasis and corneal scarring.

Inclusion conjunctivitis is not uncommon in the developed world. Like gonococcal infection, it results from sexual transmission between adults or from vertical transmission from an infected mother. In adults, the disease may take a mild chronic form with follicles seen on examination. In neonates, follicles are not seen and they may present 7-10 days after birth with a copious purulent discharge similar to that seen in gonococcal infection. This may precede the development of chlamydial pneumonitis if left untreated.

Diagnosis is confirmed by sending an adequate conjunctival scraping for chlamydial immunofluorescence and culture.

Treatment of neonates is with oral erythromycin 50mg/kg/d for 2 weeks and erythromycin ointment for 1-2 weeks. The parents must be treated as well. Treatment of adult infection is with doxycycline 100mg bd for 3 weeks. For pregnant women, erythromycin 500mg qds for 3 weeks is the alternative.

Viral conjunctivitis

This may be caused by a variety of viruses and may be endemic or epidemic. Adenovirus infection is highly contagious and the two common forms are epidemic keratoconjunctivitis and pharyngoconjunctival fever.

Treatment is symptomatic. However, when an epidemic is apparent, consideration should be given to viral cultures as part of a public health investigation.

CORNEAL INFECTIONS

Infections of the cornea require urgent and appropriate management by an ophthalmologist as they are potentially sight-threatening.

Bacterial keratitis

The two common causes in Singapore are the use of soft contact lenses and trauma due to a foreign object.

The patient commonly presents with a red eye accompanied by pain, lacrimation, mucopurulent exudate, photophobia, blurring of vision and a corneal opacity.

The common causative agents are:

- a) associated with contact lens use – *Pseudomonas aeruginosa*, other *Pseudomonas species*⁽⁵⁾ and a variety of gram-negative bacilli. *Pseudomonas aeruginosa* accounts for the majority of cases, and because this organism produces a number of potent tissue-damaging enzymes, the course of the infection may be rapidly progressive, leading eventually to corneal perforation. *Pseudomonas* is a waterborn organism and common sources of infection are the contact lens solution, case and the contact lens itself.
- b) associated with other risk factors – *S. aureus*, streptococci, *Bacillus, sp.*, pneumococci and gram-

negative bacilli. The causative organism may not be readily predicted and adequate investigations are necessary. *Bacillus* infections take a particularly fulminant course.

Investigations involve taking an adequate corneal scraping using a Kimura spatula and inoculating the specimen onto a culture plate as well as sending a portion for Gram stain. These procedures should be done by an ophthalmologist. Conjunctival swabs and the use of cotton-tipped swabs are not recommended.

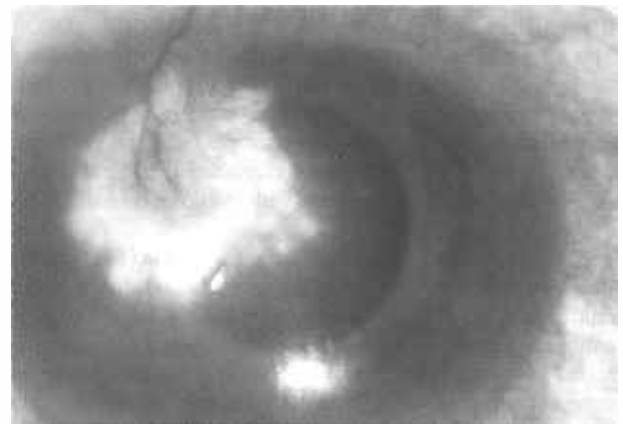
Initial treatment is with topical gentamicin and cefazolin, to be modified when initial bacteriological results are known. Subconjunctival antibiotics may be given as an initial loading dose. Fortified preparations, specially prepared by the pharmacist, given every 30-60 minutes, are needed to ensure adequate concentrations in the cornea.

Fungal keratitis

The risk factors for fungal keratitis are trauma, particularly with organic material, and the use of topical steroids. The ophthalmologist can often suspect its fungal nature by the type of corneal lesion seen. It typically presents as a chronic ulcer with indistinct finger-like margins projecting into the adjacent stroma and characteristic satellite lesions (Fig 1).

The commonest agent found is *Fusarium sp.* though *Aspergillus sp.* and *Candida sp.* may occasionally be isolated.

Fig 1 – Fungal keratitis



Investigations required are an adequate corneal scraping for fungal culture and staining for fungi. A corneal biopsy may be needed as fungi are often found in the deep corneal stroma.

Treatment is difficult. Topical antifungals like amphotericin B and natamycin, together with adequate debridement of the corneal epithelium, are needed⁽⁶⁾. However, the outcome is often poor due to the invasive nature of the fungi and their relative insensitivity to some antifungals. Early diagnosis and treatment give the best chance of saving sight.

Viral keratitis

Herpes simplex keratitis results from reactivation of latent virus. The disease takes two forms:

- a) epithelial dendritic keratitis is due to direct viral infection of the cornea. This condition should resolve with adequate debridement and the use of topical acyclovir 5 times a day for 1-2 weeks. Topical steroids are contraindicated.
- b) stromal disease, which is deeper in location and in which the damage is due to host reaction. This condition does not resolve with the use of antivirals. Topical steroids with antiviral cover is used.

Varicella-zoster virus may cause keratitis when reactivation of latent virus affects the ophthalmic branch of the trigeminal nerve. Tissue damage results from both viral cytolysis and host reaction. Lesions range from punctate epithelial keratitis and microdendrites to disciform keratitis⁽⁷⁾. The corneal lesions are insensitive to antiviral agents but usually respond to topical corticosteroids which should be slowly tapered to prevent a relapse. If given early, oral acyclovir may reduce the severity and duration of the lesions.

Acanthamoeba keratitis

This is caused by free-living amoebae. It is associated with the use of contaminated contact lens solution and home-made saline, and with swimming in polluted waters. Although uncommon, it carries a poor prognosis. Typical ring-shaped paracentric corneal lesions may be seen⁽⁸⁾. Microscopy and special culture techniques may be used to identify the amoeba. Treatment has been attempted with topical propamidine ointment and drops.

LACRIMAL APPARATUS

The lacrimal apparatus consists of a tear-producing gland with ducts leading into the conjunctival fornix and a drainage system consisting of an upper and lower canaliculus, a common canaliculus, a lacrimal sac and a nasolacrimal duct which drain the tears into the nose. The commonest infection is that of the lacrimal sac (dacryocystitis) (Fig 2). A blocked nasolacrimal duct predisposes to this infection which manifests as an inflamed swelling inferomedial to the eye. This may be acute or chronic. Infective agents include *S. aureus*, pneumococci, *Haemophilus influenzae* and various gram-negative bacilli. An acute infection is treated with an oral antibiotic eg cloxacillin and warm compresses. An abscess, if present, may be drained with a 14G needle. Incision and drainage is not recommended as this may be complicated by fistula formation.

Canaliculitis is characterised by discharge and a pouting punctum. Concretions may be present. This may be associated with duct blockage and infection. Treatment is with topical penicillin and warm compress.

Fig 2 - Dacryocystitis



ENDOPHTHALMITIS

Endophthalmitis refers to a severe form of intraocular inflammation without extension of the inflammatory process beyond the sclera. It may be infective or non-infective, exogenous or endogenous. Symptoms include pain and visual loss. Oedema of the eyelids, chemosis, anterior chamber activity and vitritis are characteristic.

Infective exogenous endophthalmitis occurs in two situations:

- a) post-surgical: although uncommon (1/1000 cataract operations), the consequences can be disastrous. Patients typically present within the first post-operative week with pain, tearing and blurred vision. Common organisms are coagulase-negative *staphylococci*, *S. aureus*, *streptococci* and various gram-negative bacilli⁽⁹⁾. *Propionibacterium acnes* is an anaerobic bacillus which has been increasingly recognised as a cause of late-onset endophthalmitis. A diagnostic vitreous tap for bacteriological investigation is essential. Treatment is with intra-vitreous and parenteral antibiotics. This may be combined with vitrectomy in severe cases.
- b) post-traumatic: this occurs particularly after a penetrating injury by a foreign body. In addition to the above organisms, *Bacillus sp.*, unusual environmental gram-negative bacilli and fungi may be isolated. The foreign body needs to be removed and appropriate antibiotics given.

Endogenous endophthalmitis is due to haematogenous seeding of the eye from systemic infection, and usually occurs in the context of immunosuppression, patients with intravenous lines, intravenous drug users and patients with underlying endocarditis or other focus of infection. A variety of organisms may be responsible, including *S. aureus*, streptococci, pneumococci, gram-negative bacilli, *Nocardia sp.* and *candida*. Diagnostic investigations and treatment are as above. In addition, blood cultures should be taken and a search made for causes of immunosuppression or underlying distant foci of infection, where these are not already known.

ORBITAL INFECTIONS

Preseptal cellulitis

This is an infection located anterior to the orbital septum. It does not carry the grave prognosis of the orbital cellulitis (Fig 3). It presents with periorbital swelling, redness and tenderness. Ocular motility is unimpaired, the vision is good and both pupils are equal and reactive to light and there is no proptosis. The likely organisms are group A *streptococci*, *S. aureus* and, in children, *H. influenzae*⁽¹⁰⁾. A diagnostic specimen may not be obtainable where the integrity of the overlying skin is intact. Empiric treatment aimed at the above organisms include oral or parenteral cloxacillin with ampicillin. Alternative regimens include cefuroxime, amoxicillin-clavulanic acid or ceftriaxone with cloxacillin. Unless severe, treatment may be carried out on an outpatient basis.

Orbital cellulitis

This involves tissues in the orbit posterior to the orbital septum and can threaten the sight of the patient by compression of the optic nerve and blood vessels. Spread to the cavernous sinus may result in life-threatening infection. Progression may be very rapid and early diagnosis and aggressive treatment may be life- and sight-saving.

The routes of infection are:

- a) contiguous – usually from infection of a paranasal sinus; also from a dental abscess or otitis media;
- b) direct inoculation – from open trauma to the orbit or after surgery;
- c) haematogenous – from a distant focus of infection eg endocarditis

The patient presents with a relatively sudden onset of unilateral pain, periorbital swelling and chemosis with limitation of eye movements and proptosis (Fig 3). If the optic nerve is involved, the vision may be impaired and a relative afferent pupillary defect present. Fever and lethargy are common accompanying symptoms.

The organism responsible depends on the origin of the infection. After a traumatic injury, *S. aureus*⁽¹¹⁾ should be considered. If the infection was due to extension of a sinus infection, a mixed flora including streptococci, anaerobes, *H. influenzae* and possibly gram-negative bacilli may be isolated⁽¹²⁾. In diabetics, leukaemics and other neutropaenic patients, infection by filamentous fungi like *Mucor*, *Aspergillus* and *Rhizopus* takes place through contiguous spread from an adjacent sinus. The patient should be immediately referred to an ophthalmologist for hospitalised treatment. Attempts to obtain a diagnostic tap may not always be easy and should never delay the institution of appropriate antibiotics. Therapy should be aimed at the likely organisms, and a search made for an underlying focus in appropriate circumstances. Surgical drainage may be needed.

Fig 3 – Orbital cellulitis



OTHER INFECTIONS ASSOCIATED WITH THE EYE

Tuberculosis

Tuberculosis affecting the eye is now not commonly seen in Singapore. The protean ocular manifestations include iridocyclitis, scleritis, choroiditis, retinitis and optic neuritis. These may develop in the absence of clinically active systemic disease.

Syphilis

Syphilis is now less commonly seen, but is notorious for mimicking other forms of ocular inflammation. Eye involvement includes interstitial keratitis, anterior uveitis and chorioretinitis giving rise to a "salt and pepper" appearance. Optic neuritis may occur in some cases. When ocular syphilis is diagnosed, treatment should be as for neurosyphilis.

Leprosy

This is also uncommon in Singapore. Involvement of the seventh cranial nerve results in exposure keratopathy which may lead to corneal complications. Interstitial keratitis and anterior uveitis are common complications of the disease.

Toxoplasmosis

Congenital toxoplasmosis is typically characterised by a large atrophic scar in the macula secondary to toxoplasma retinochoroiditis. Recurrence of old healed congenital toxoplasmosis typically occurs between the ages of 10 and 35 and may be accompanied by vitritis and anterior uveitis. In an immunocompetent patient, the disease is self-limiting. If the inflammation threatens the vision by involving the macula, optic nerve or by causing a hazy vitreous, specific antitoxoplasma treatment (eg pyrimethamine-sulfadiazine) can be used in combination with oral steroids.

Cytomegalovirus (CMV) retinitis

Congenital CMV infection may be associated with congenital cataracts, optic atrophy and multiple retinochoroidal scars. CMV retinitis in adults affects the immunocompromised, particularly in those with AIDS (Fig 4). Patients complain of blurred vision and fundal examination reveals an exudative retinitis with retinal haemorrhage due to occlusive vasculitis⁽¹³⁾. This tends to be bilateral.

Fig 4 – Cytomegalovirus retinitis



HIV infection

Ocular involvement in HIV patients takes many forms, including non infectious retinopathy, Kaposi sarcoma, cranial nerve palsy and papilloedema from cerebral involvement and infection⁽¹⁴⁾. The most important ocular infection is CMV retinitis. Other ocular infections include syphilis, toxoplasmosis, tuberculosis, candidiasis, cryptococcosis and herpes zoster.

CONCLUSION

The eye and its adnexal structures are usually remarkably free from infection. Infections, when they do occur, may range from the mild and self-limiting to the sight- and life-threatening. Doctors in the community, in outpatient clinics and in general hospital wards should be alert to situations in which referral to an ophthalmologist is needed for specialised examination or urgent intervention.

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