

Chapter 12

Eye Infections

EYE INFECTIONS: A large number of local and systemic conditions of non-infectious origin are reflected in the eye and may mimic eye infections. However, the most common cause of failure to isolate organisms from an apparent infection is prior use of local antimicrobial preparations.

PURULENT CONJUNCTIVITIS: 2% of new episodes of illness in UK; 0.5% of ambulatory care visits in USA

Agents: *Haemophilus* (mainly *Haemophilus influenzae* (especially young children; 62% of cases bilateral; conjunctival injection in 86% of cases, purulent discharge in 77%), also *Haemophilus aegyptius*), *Streptococcus pneumoniae* (occasional ophthalmia neonatorum, outbreaks in students and military recruits, sporadic), *Streptococcus pyogenes*, other streptococci (? , ? , microaerophilic), *Staphylococcus aureus* (ophthalmia neonatorum), *Moraxella lacunata* (Axenfeld conjunctivitis (diplobacillary conjunctivitis, Morax-Axenfeld conjunctivitis, subacute conjunctivitis); not significant cause in certain areas), *Moraxella catarrhalis*, *Escherichia coli*, *Neisseria gonorrhoeae* (gonococcal conjunctivitis (gonococcal ophthalmia, gonorrhoeal conjunctivitis, gonorrhoeal ophthalmia); acute purulent conjunctivitis usually unilateral in adults (blepharitis adutorum) and bilateral in newborn infants (blepharitis neonatorum); may lead to corneal ulceration and, if untreated, to impairment or loss of vision), *Neisseria meningitidis* (rare except in central and northern Australia; corneal ulcers in 16%; systemic disease in 18%, with 13% case-fatality rate in those cases), *Neisseria mucosa* (rare neonatal), *Acinetobacter calcoaceticus*, *Corynebacterium diphtheriae* (uncommon; resulting from inoculation into eye), *Mycobacterium tuberculosis*, *Corynebacterium striatum* (rare), *Vibrio parahaemolyticus*, *Vibrio alginolyticus*, *Capnocytophaga*, *Pseudomonas aeruginosa* (antecedent corneal trauma, contact lens wear, concurrent serious systemic disease), *Stenotrophomonas maltophilia* (occasional), *Kingella indologenes* (rare), *Listeria monocytogenes*, *Erysipelothrix rhusiopathiae*, *Bacillus subtilis*, *Candida* (*Candida albicans* common; *Candida tropicalis*, *Candida stellatoidea*, *Candida parapsilosis*, *Torulopsis glabrata* infrequent to rare); any organism other than a light growth of coagulase negative staphylococcus, *Corynebacterium* species other than *Corynebacterium diphtheriae* or *Corynebacterium striatum*, or *Streptococcus viridans*, should be considered possibly significant

Diagnosis: moderate injection, moderate to profuse exudate, follicles absent, no preauricular node enlargement; *Moraxella lacunata* mainly affects area of the canthi; Gram stain and culture of swab of pus or conjunctiva

Gonococcal in Neonate: age 2-4 d at onset, bilateral, marked oedema, copious purulent discharge; polymorphs and Gram negative diplococci in smear

Treatment:

Neisseria meningitidis: ceftriaxone 25 mg/kg to 1 g i.m. daily for 3-5 d

Neisseria gonorrhoeae:

Neonates:

Penicillinase Negative: benzylpenicillin 15 mg/kg i.v. 12 hourly during first week of life and 7.5 mg/kg thereafter for total of 7 d

Penicillin Resistant or Susceptibility Not Known: cefotaxime 50 mg/kg i.v. 8 hourly for 7 d or ceftriaxone 50 mg/kg i.v. daily for 7 d

Others: procaine penicillin 50 mg/kg to 1.5 g i.m. daily for 1-3 d, amoxicillin 75 mg/kg to 3g + probenecid 25 mg/kg to 1 g (not < 2 y) orally daily for 1-3 d

Penicillinase-Producing, Penicillin Hypersensitive: ceftriaxone 25 mg/kg to 1 g i.m. or i.v. as single dose or cefotaxime 25 mg/kg to 1 g i.m. or i.v. as single dose

Mycobacterium tuberculosis requires specialised attention; corticosteroids must not be used

***Staphylococcus aureus* (Serious Ophthalmia Neonatorum):** i.v. cloxacillin for 7 d

Listeria monocytogenes: ampicillin 2 g i.v. 4 hourly (< 1 w: 100 mg/kg daily in 2 divided doses; 1-4 w: 200 mg/kg daily in 3 divided doses; older children: 200-400 mg/kg daily in 4 divided doses) for 2 w + gentamicin

1.3 mg/kg (child: 1.5-2.5 mg/kg) 8 hourly; benzylpenicillin 15-20 MU (neonates: 500 000-1 MU; older children: 200 000-400 000 U/kg) daily in divided doses for 2 w + gentamicin 1.3 mg/kg (child: 1.5-2.5 mg/kg) i.v. 8 hourly; cotrimoxazole 320/1600 mg (child: 8/40 mg/kg) i.v. daily in divided doses

Pseudomonas aeruginosa: topical tobramycin ? parenteral aminoglycoside ? ticarcillin or piperacillin

Stenotrophomonas maltophilia: cotrimoxazole ? rifampicin

***Haemophilus aegyptius* (BPF Clone)**: oral rifampicin 20 mg/kg/d for 4 d

Other Bacteria:

Mild: propamide isethionate 0.1% 1-2 drops 3-4 times daily for 5-7 days

More Severe: chloramphenicol 0.5% eye drops topically 1-2 drops every 2 h, decreasing to 4 times daily as infection improves + chloramphenicol 1% eye ointment topically at night for 3-5 d or framycetin 0.5% eye drops 1-2 drops every 1-2 h, decreasing to 8 hourly as infection improves

Candida: amphotericin B + flucytosine

Prophylaxis:

***Neisseria gonorrhoeae* in Neonates**: single application of 0.5% erythromycin ointment, 1% tetracycline ointment or 1% silver nitrate

Neisseria meningitidis: ceftriaxone 250 mg (child 125 mg) i.m. as single dose (preferred if pregnant), ciprofloxacin 500 mg orally as single dose (not < 12 y; preferred for women taking oral contraceptive), rifampicin 10 mg/kg to 600 mg orally 12 hourly for 2 d (not pregnant, alcoholic, severe liver disease; preferred for children)

CHLAMYDIAL CONJUNCTIVITIS (ENDEMIC PARATRACHOMA, INCLUSION BLENNORRHOEA, INCLUSION CONJUNCTIVITIS, OCCIDENTAL PARATRACHOMA, OCULOGENITAL INCLUSION CONJUNCTIVITIS, PARATRACHOMA): transmitted to eye from infected genital secretions, also via secretions and fomites in endemic areas; acute or chronic, with conjunctival follicles and mucopurulent discharge

Agent *Chlamydia trachomatis* (TRIC agent)

Diagnosis:

Neonatal (Inclusion Conjunctivitis of Newborn, Ophthalmia Neonatorum): age 7-10 d at onset, unilateral or bilateral, redness and moderate oedema of lids, copious purulent or mucopurulent discharge, diffuse conjunctival injection; culture, cytology (polymorphs and intracytoplasmic inclusions on Giemsa stain) and immunofluorescence of scrapings from conjunctiva

Older Patients: acute or chronic; conjunctival follicles and mucopurulent discharge; culture, cytology and immunofluorescence of scrapings from lower fornix

Treatment:

Adults, Children > 6 kg: azithromycin 20 mg/kg to 1 g orally as single dose to clinical case, caregivers and close children

Children ? 6 kg: erythromycin base 10 mg/kg or erythromycin ethyl succinate 20 mg/kg orally 6 hourly for 21 d

Prophylaxis: 0.5% erythromycin ophthalmic ointment, 1% tetracycline ophthalmic ointment

TRACHOMA (ARLT DISEASE, ARLT TRACHOMA, EGYPTIAN OPHTHALMIA, MILITARY OPHTHALMIA): affects 15% of world's population; very common in developing countries, especially N Africa and Arab countries; in Australia, mainly in Aborigines; ? 10 cases/y in USA; usually chronic immunopathologic disease in which more severe progressive trachoma infections (active trachoma characterised by follicle formation and papillary hypertrophy in conjunctiva, vascularisation and corneal infiltration (pannus), followed by healed trachoma in which there is scarring of eyelids and cornea, sometimes leading to partial or total loss of sight) occur only after reinfection; transmission by contact with infectious discharge

Agent *Chlamydia trachomatis*

Diagnosis: follicle formation and papillary hypertrophy in conjunctiva, infiltration of cornea, scarring of lids and cornea; cytology (Giemsa stain sensitivity 29%, specificity 100%) and immunofluorescence (Microtrak-methanol fix sensitivity 78%, specificity 100%), culture (sensitivity 76%, specificity 100%), DNA probe (sensitivity 84%, specificity 96%) of scrapings from upper tarsus; serology

Treatment: as for **CHLAMYDIAL CONJUNCTIVITIS**

Prophylaxis (5-14 y): oily tetracycline drops, 1 drop once daily for 5 consecutive days in each school month

Prevention and Control: hygiene; treatment of cases; fly control

NONPURULENT CONJUNCTIVITIS ('PINK EYE'): common in children

Agents: herpes simplex (uncommon; may involve cornea; occasional ophthalmia neonatorum), varicella-zoster, measles (46% of hospitalised measles cases also develop bacterial conjunctivitis), rubella, dengue, sandfly fever, echovirus 17 and 18, coxsackievirus A9, Newcastle disease virus, adenovirus (common cause of swimming pool conjunctivitis; types 1-10, 16 (in 50% of infections), 17, 19, 37), enterovirus 70, influenza A, influenza B (eye discharge and discomfort in 8% of cases), cytomegalovirus in AIDS, Rocky Mountain spotted fever (in 30% of cases; 13% in first 3 d), Crimean-Congo haemorrhagic fever, Mediterranean spotted fever (in 32% of cases), infectious mononucleosis, *Chlamydia*, *Acanthamoeba*, *Acinetobacter* (contact lenses); also toxic shock syndrome, allergic, caused by silver nitrate prophylaxis, caused by unshielded mercury vapour lamps, sensitivity reaction, chemical irritants

Diagnosis: intact vision, mild pain, mild diffuse injection, minimal exudate present, photophobia absent, lacrimation and pupil normal, follicles present, preauricular node enlargement; cytology, immunofluorescence and viral culture of swab of mucus or corneal or conjunctival scraping; serology

Acanthamoeba: Giemsa-Wright, Wheatley trichrome, calcofluor white/methylene blue, fluorescein conjugated lectin, Gomori methenamine silver, PAS or immunofluorescent stain and culture of scraping from corneal ulcer; electron microscopy of biopsy

Treatment:

Chlamydia: erythromycin

Acinetobacter:

Mild: propamide isethionate 0.1% 1-2 drops 6-8 hourly for 5-7 days

More Severe: (polymyxin B sulphate 5000 U/mL + chloramphenicol 0.5% or neomycin 2.5 mg/mL) 1-2 drops hourly, decreasing to 6 hourly as infection improves + eye ointment as above at bedtime for 3-5 d; chloramphenicol 0.5% eye drops topically 1-2 drops at least 4 times daily to both eyes for 3-5 d + chloramphenicol 1% eye ointment topically at night for 3-5 d; chloramphenicol eye ointment topically 6 hourly for 3-5 d; oily tetracycline eye drops 1-2 drops at least 4 times daily to both eyes for 3-5 d

Acanthamoeba: propamide isethionate, dibromopropamide isethionate, clotrimazole + neomycin or gentamicin, Baquacil (10^3 dilution)

Herpes simplex:

Mild: aciclovir 3% eye ointment 1 cm 3 hourly, idoxuridine 0.1% eye drops 1 drop in each eye every h during day and every 2 h at night till improvement, idoxuridine 0.5% eye ointment 1 cm 4 times daily and at night, vidarabine 3% eye ointment 1.5 cm 5 times daily at 3 hourly intervals, reducing to twice daily for 7 d after reepithelialisation has occurred

Severe: aciclovir 5 mg/kg (< 12 y: 250 mg/m²) 8 hourly i.v. as 1 h infusion for 5 d

Varicella-zoster: cool compresses, topical lubrication, topical broad spectrum antibiotic

Allergy: sodium cromoglycate drops

Others: cold compresses, artificial tears, phenylephrine 0.12%, avoidance of bright light, systemic analgesics

ACUTE HAEMORRHAGIC CONJUNCTIVITIS: highly contagious; due to poor hygiene

Agents: adenovirus 11, coxsackievirus A24, enterovirus 70; conjunctival haemorrhages and injection also occur in 57% of cases of haemorrhagic fever with renal syndrome

Diagnosis: conjunctival congestion, bilateral conjunctival injection and irritation in 93% of cases, conjunctival watering, scanty white to profuse watery discharge; viral culture of conjunctival swab; haemagglutination inhibition test

Treatment: betamethasone drops

CONJUNCTIVAL CONGESTION AND INJECTION also occur in 88% of cases of Kawasaki syndrome

CONJUNCTIVAL HYPERAEMIA is present in 80% of toxic shock syndrome cases

CONJUNCTIVAL SUFFUSION is common in psittacosis

CONJUNCTIVITIS AND KERATITIS (KERATOCONJUNCTIVITIS)

Agents: group D adenovirus (types 7, 8, 18, 19, 37; in developed countries, epidemic and primarily iatrogenic and affecting mainly adults; in developing countries, endemic and primarily disease of children), herpes simplex, herpes zoster, AIDS, *Listeria monocytogenes*, *Acinetobacter* (contact lens), *Acanthamoeba* (contact lens)

Diagnosis: eye redness in 98% of cases, eye discharge in 95%; fluorescein staining of cornea; culture of nasopharyngeal swab, swab or scraping of conjunctiva and cornea, faeces; cytology, immunofluorescence and culture of corneal or conjunctival scraping; serology

***Acanthamoeba*:** Giemsa-Wright, Wheatley trichrome, calcofluor white/methylene blue, fluorescein conjugated lectin, Gomori methenamine silver, PAS or immunofluorescent stain and culture of scraping from corneal ulcer; electron microscopy of biopsy

Treatment:

Adenovirus: non-specific

Herpes simplex: aciclovir 3% ophthalmic ointment 5 times daily for 14 days or for at least 3 d after healing + atropine 1% 1 drop 12 hourly for duration of treatment

Herpes zoster: famciclovir 250 mg orally 8 hourly for 7 d (500 mg orally 8 hourly for 10 days in immunocompromised), valaciclovir 1 g orally 8 hourly for 7 d, aciclovir 20 mg/kg to 800 mg orally 5 times daily for 7 d (preferred in children and in pregnancy); if sight is threatened, aciclovir 10 mg/kg i.v. 8 hourly, each infusion administered over a period of 1 h, for 7 days (adjust dose for renal function); aciclovir 3% eye ointment 5 times daily may be added

Epithelial Keratitis: debridement or none

Stromal Keratitis: topical steroids

Neurotropic Keratitis: topical lubrication, topical antibiotics for secondary infections, tissue adhesives and protective contact lenses to prevent corneal perforation

***Listeria monocytogenes*:** ampicillin or benzylpenicillin + gentamicin, cotrimoxazole

***Acinetobacter*:** topical tobramycin, polymyxin B

KERATITIS AND IRITIS: 0.01% of new episodes of illness in UK

Agents: herpes simplex, varicella-zoster, AIDS, *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Streptococcus pneumoniae*, *Moraxella lacunata*, ?-haemolytic streptococci, Gram negative bacilli (associated with soft contact lenses), *Mycobacterium chelonae*, *Mycobacterium fortuitum* (emerging pathogen in AIDS), *Mycobacterium tuberculosis*, *Aspergillus*, *Fusarium*, *Curvularia*, *Dreschlera*, *Alternaria*; *Acinetobacter*, *Acanthamoeba castellanii*, *Acanthamoeba culbertsoni*, *Acanthamoeba hatchetii*, *Acanthamoeba polyphaga* and *Acanthamoeba rhysoides* (associated with soft contact lenses, hot tubs, unsterile water); also interstitial keratitis due to congenital syphilis or complication of tuberculosis or leprosy, *Sarcopodium oculorum*

Diagnosis: vision may be compromised, severe pain, injection localised to iris ('ciliary flush'), exudate absent, photophobia present, lacrimation increased, pupil contracted; cytology and culture of swabs, scrapings of cornea, corneal biopsy; immunodiffusion, immunofluorescence

***Acanthamoeba*:** Giemsa-Wright, Wheatley trichrome, calcofluor white/methylene blue, fluorescein conjugated lectin, Gomori methenamine silver, PAS or immunofluorescent stain and culture of scraping from corneal ulcer; electron microscopy of biopsy

Treatment:

Herpes simplex, Varicella-zoster: see **CONJUNCTIVITIS AND KERATITIS**

***Mycobacterium tuberculosis*:** isoniazid 10 mg/kg to 300 mg orally once daily or 15 mg/kg to 600 mg orally 3 times weekly for 6 mo [+ pyridoxine 25 mg (breastfed baby 5 mg) orally with each dose] + rifampicin 10 mg/kg to 600 mg orally once daily 1 h before breakfast or 15 mg/kg to 600 mg orally 3 times a week for 6 mo + pyrazinamide 25-35 mg/kg to 2 g orally once daily or 50 mg/kg to 3 g orally 3 times weekly for 2 mo (6 mo if not known to be susceptible to isoniazid and rifampicin) + ethambutol 15 mg/kg orally daily (not < 6 y or plasma creatinine > 160 µM/L; regular ocular monitoring) or 30 mg/kg orally 3 times weekly for 2 mo or until known to be susceptible to isoniazid and rifampicin (to 6 mo)

Other *Mycobacterium*: sulphacetamide drops

Other Gram Positive Bacteria: povidone iodine ? topical prednisolone

Gram Negative Bacilli: topical tobramycin, polymyxin B

Fungi: topical pimaricin ± ketoconazole; keratoplasty

Acanthamoeba: propamidine isethionate, dibromopropamidine isethionate, clotrimazole + neomycin or gentamicin, Baquacil (10³ dilution)

PENETRATING EYE INJURIES

Treatment: specialised management required; urgent advice from ophthalmologist mandatory; if significant delay before specialised treatment, vancomycin 20 mg/kg to 1 g i.v. slowly single dose + ciprofloxacin 15 mg/kg to 750 mg orally single dose; gentamicin 5 mg/kg single dose + cefotaxime 50 mg/kg to 1 g i.v. single dose or ceftriaxone 50 mg/kg to 1 g i.v. single dose

ONCHOCERCIASIS (RIVER BLINDNESS): Sub-Saharan Africa, Latin America; incidence 18 M/y; no deaths reported but 270 000 reported cases of blindness annually; transmitted by blackflies, *Simulium*

Agent: *Onchocerca volvulus*; recent report that real culprit is *Wolbachia* carried by the worms

Diagnosis: sclerosing keratitis, chronic iridocyclitis, chorioretinitis, optic atrophy; biopsy of nodule will disclose adult worm, while skin shavings may show microfilariae; slit-lamp eye examination (punctate keratitis, microfilariae in cornea); nodules can be detected by ultrasound; a patch test in which blot of 10% diethylcarbamazine in anhydrous lanolin fixed to skin produces pruritus, oedema and papule formation within 72 h is positive in up to 92% of cases; eosinophilia

Treatment: ivermectin 20 µg/kg orally once as a single dose, diethylcarbamazine under expert supervision, suramin (if ocular microfilariae present after diethylcarbamazine and nodulectomy) 50 mg test dose i.v. then 10-15 mg/kg to maximum dose 1 g orally for 5 w, flubendazole 750 mg i.m. once a week for 5 doses; tetracycline to kill *Wolbachia*?

CHRONIC EYE INFECTIONS

Agents: *Pseudomonas*, *Proteus*, *Escherichia coli*, *Klebsiella*, anaerobes, fungi (*Fusarium*, *Alternaria*, *Pseudallescheria boydii*, *Candida albicans*, others)

Diagnosis: culture of corneal, conjunctival scrapings

Treatment: dependent on findings

IRIDOCYCLITIS (CYCLITIS + IRITIS)

Agents: varicella-zoster, AIDS, *Bacillus*, *Pseudomonas aeruginosa*

Diagnosis: cytology, Gram stain and culture of swabs, scrapings

Treatment:

Varicella-zoster: as for **CONJUNCTIVITIS AND KERATITIS**

Bacillus: clindamycin

Pseudomonas aeruginosa: topical tobramycin, polymyxin B

ANTERIOR UVEITIS (CHOROIDITIS + IRIDOCYCLITIS)

Agents: herpes simplex, mumps, varicella-zoster, measles, AIDS, *Mycobacterium tuberculosis*, *Treponema pallidum* (secondary syphilis), *Neisseria gonorrhoeae*, *Brucella*, Rocky Mountain spotted fever, *Leptospira*, *Listeria monocytogenes*, *Histoplasma capsulatum*, *Toxoplasma gondii*, *Toxocara canis*, *Acanthamoeba*, also rheumatoid arthritis, sarcoidosis, Reiter syndrome, Behcet's disease, inflammatory bowel disease

Diagnosis: smear and culture of aspirate; serology

Treatment: prompt referral to ophthalmologist

Herpes simplex, Herpes zoster: see **CONJUNCTIVITIS AND KERATITIS**

Mycobacterium tuberculosis: isoniazid 10 mg/kg to 300 mg orally once daily or 15 mg/kg to 600 mg orally 3 times weekly for 6 mo [+ pyridoxine 25 mg (breastfed baby 5 mg) orally with each dose] + rifampicin 10 mg/kg to 600 mg orally once daily 1 h before breakfast or 15 mg/kg to 600 mg orally 3 times a week for 6 mo + pyrazinamide 25-35 mg/kg to 2 g orally once daily or 50 mg/kg to 3 g orally 3 times weekly for 2 mo (6 mo if not known to be susceptible to isoniazid and rifampicin) + ethambutol 15 mg/kg orally daily (not < 6 y or plasma creatinine > 160 µM/L; regular ocular monitoring) or 30 mg/kg orally 3 times weekly for 2 mo or until known to be susceptible to isoniazid and rifampicin (to 6 mo)

Syphilis: aqueous crystalline penicillin G 3-4 MU i.v. every 4 h or 18-24 MU/d as continuous infusion for 10-14 d, procaine penicillin 2.4 MU i.m. once daily + probenecid 500 mg orally 4 times a day for 10-14 d

Histoplasma capsulatum: amphotericin B, flucytosine, ketoconazole ? steroids

Toxoplasma: corticosteroids + sulphadiazine 1-1.5 g orally or i.v. 6 hourly for 3-6 w then 500 mg orally 6 hourly or 1 g orally 12 hourly + pyrimethamine 50-100 mg orally loading dose then 25-50 mg daily for 3-6 w (continue if necessary)

Sulphadiazine Hypersensitive: substitute clindamycin 600 mg orally or i.v. 6 hourly for 3-6 w

Toxocara canis: thiabendazole

Acanthamoeba: propamidine isethionate, dibromopropamidine isethionate, clotrimazole + neomycin or gentamicin, Baquacil (10³ dilution)

CHORIORETINITIS (CHOROIDITIS + RETINITIS)

Agents: *Mycobacterium tuberculosis*, *Nocardia*, *Candida*, *Aspergillus*, *Cryptococcus neoformans* (associated with meningitis), *Histoplasma capsulatum*, also sarcoidosis

Diagnosis: clinical; serology; culture of anterior chamber and vitreous aspirates

Treatment:

Mycobacterium tuberculosis: isoniazid 10 mg/kg to 300 mg orally once daily or 15 mg/kg to 600 mg orally 3 times weekly for 6 mo [+ pyridoxine 25 mg (breastfed baby 5 mg) orally with each dose] + rifampicin 10 mg/kg to 600 mg orally once daily 1 h before breakfast or 15 mg/kg to 600 mg orally 3 times a week for 6 mo + pyrazinamide 25-35 mg/kg to 2 g orally once daily or 50 mg/kg to 3 g orally 3 times weekly for 2 mo (6 mo if not known to be susceptible to isoniazid and rifampicin) + ethambutol 15 mg/kg orally daily (not < 6 y or plasma creatinine > 160 µM/L; regular ocular monitoring) or 30 mg/kg orally 3 times weekly for 2 mo or until known to be susceptible to isoniazid and rifampicin (to 6 mo)

Nocardia: cotrimoxazole

Fungi: amphotericin B + steroids

RETINOCHOROIDITIS (RETINITIS + CHOROIDITIS)

Agents: cytomegalovirus (in renal transplantation, AIDS), herpes simplex, varicella-zoster, *Toxoplasma gondii* (20% of cases of posterior uveitis), *Toxocara canis*

Diagnosis: clinical; serology; culture of anterior chamber and vitreous aspirates

Cytomegalovirus: characteristic appearance on serial ophthalmoscopic examinations (eg., discrete patches of retinal whitening with distinct borders, spreading in a centrifugal manner along the paths of blood vessels, progressing over several months, and frequently associated with retinal vasculitis, haemorrhage and necrosis); resolution of active disease leaves retinal scarring and atrophy with retinal pigment epithelial mottling

Toxoplasma: intense white focal area of retinal necrosis with substantial inflammation

Varicella-zoster: rapid spread; 67% completely blind within 1 mo

Treatment:

Herpes simplex: famciclovir 500 mg orally 12 hourly for 7-10 d, valaciclovir 500 mg orally 12 hourly for 7-10 d, aciclovir 200 mg orally 5 times daily for 7-10 d

Herpes Zoster: as for **CONJUNCTIVITIS AND KERATITIS**

Cytomegalovirus: valganciclovir 900 mg orally 12 hourly for 14-21 d then 900 mg orally daily, ganciclovir 5 mg/kg i.v. twice a day for 2-3 w then 10 mg/kg i.v. 3 times a week or 5 mg/kg i.v. 5 times a week during continued immunosuppression, foscarnet 90 mg/kg i.v. 12 hourly for 2-3 w then 90-120 mg/kg i.v. 5 times weekly, cidofovir 5 mg/kg i.v. weekly for 2 w (+ probenecid if proteinuria ? 2+ and creatinine clearance ? 55 mL/min) then as above every 2 w

Other Viral: reduction of immunosuppressive therapy

Toxoplasma: pyrimethamine 25 mg 3 times first day then orally daily for 4 w (child: 2 mg/kg to 25 mg maximum daily for 3 d, then 1 mg/kg daily (infant: every second or third d) for 4 w + trisulphapyrimidine or sulphadiazine 2 g then 1 g (child: 50 mg/kg) orally 4 times daily for 4 w + folic acid 3-9 mg orally daily; clindamycin 300 mg orally 6 hourly (child: 16 mg/kg daily in 3 or 4 doses) for 3-4 w then 150 mg 4 times daily (child: 8 mg/kg daily in 3 or 4 doses) for 3-4 w; spiramycin 1 g twice daily (recommended in pregnancy);

azithromycin 500 mg loading dose then 250 mg daily; atovaquone; + corticosteroids; surgery as needed for complications

Toxocara canis: thiabendazole

ENDOPHTHALMITIS: surgery, trauma, penetrating corneal ulcer, systemic infection

Agents: *Staphylococcus aureus* (postoperative, posttraumatic, septicemia), coagulase negative staphylococci (postoperative, posttraumatic), *Propionibacterium acnes* (postoperative), *Corynebacterium* (postoperative), *Streptococcus pneumoniae* (septicemia), *Streptococcus viridans* (conjunctival filtering-bleb associated, bloodborne), *Streptococcus pyogenes* (septicemia, posttraumatic), *Listeria monocytogenes* (oculoglandular listeriosis (angioso-septic listeriosis); uncommon; caused by accidental inoculation into eye), *Bacillus cereus* (posttraumatic, bloodborne), aerobic Gram negative bacilli (< 20% of cases; especially *Proteus mirabilis*, *Klebsiella pneumoniae* (especially in diabetics), *Escherichia coli* (bloodborne), *Enterobacter* and *Pseudomonas aeruginosa* (postoperative, antecedent corneal ulcers, penetrating trauma, metastatic seeding from bacteraemia), *Burkholderia cepacia*, *Aeromonas* (foreign body trauma), *Actinobacillus actinomycetemcomitans* and *Haemophilus paraprophilus* (in association with endocarditis), *Pasteurella multocida* and CDC EF-4b (cat scratch), *Moraxella* (postoperative), *Achromobacter* (postoperative), *Flavobacterium meningosepticum* (postoperative), *Haemophilus influenzae* (postoperative and conjunctival filtering-bleb associated), *Butyrivibrio fibrosolvens* (single case following penetrating injury), *Nocardia asteroides*, *Mycobacterium tuberculosis*, *Actinomyces* (postoperative), *Candida albicans* and other *Candida* species (associated with parenteral hyperalimentation and in immunocompromised, postoperative, i.v. drug abuse), *Aspergillus* (rare; bloodborne), *Cryptococcus neoformans* (rare; bloodborne), *Scedosporium* and *Pseudallescheria boydii* (in immunocompromised), *Coccidioides immitis* (bloodborne), *Sporothrix schenckii* (bloodborne), *Blastomyces dermatitidis* (bloodborne), *Histoplasma capsulatum* (bloodborne), other fungi (i.v. narcotic abuse)

Diagnosis: intense pain, decreased visual acuity, marked corneal swelling, lid oedema, intense hyperaemia of globe, conjunctival chemosis, hypopyon, anterior uveitis, opacity of cornea and vitreous, occasional rupture of globe; Gram stain and Giemsa, methenamine silver or PAS stain, culture (including in blood culture bottle) of aspirate of anterior chamber or vitreous cavity or fine needle retinal biopsy; blood cultures; culture of wound abscess, fistula, conjunctiva

Treatment: vitrectomy or vitreous aspiration if loculated infection or necrotic tissue +:

Empirical Where Delay In Diagnosis: ciprofloxacin 15 mg/kg to 750 mg orally as a single dose + vancomycin 25 mg/kg to 1.5 g (child < 12 y: 30 mg/kg to 1.5 g i.v. as single dose by slow infusion; gentamicin 5 mg/kg i.v. as single dose + cefotaxime 50 mg/kg to 2 g i.v. as single dose or ceftriaxone 50 mg/kg to 2 g i.v. as single dose

Nocardia: cotrimoxazole 20/100 mg/kg/d i.v. for 5 d, then 320/1600 mg orally 4 times a day

Pseudomonas aeruginosa: parenteral, topical, subconjunctival and intraocular antipseudomonal antibiotics

Mycobacterium tuberculosis: isoniazid 10 mg/kg to 300 mg orally once daily or 15 mg/kg to 600 mg orally 3 times weekly for 6 mo [+ pyridoxine 25 mg (breastfed baby 5 mg) orally with each dose] + rifampicin 10 mg/kg to 600 mg orally once daily 1 h before breakfast or 15 mg/kg to 600 mg orally 3 times a week for 6 mo + pyrazinamide 25-35 mg/kg to 2 g orally once daily or 50 mg/kg to 3 g orally 3 times weekly for 2 mo (6 mo if not known to be susceptible to isoniazid and rifampicin) + ethambutol 15 mg/kg orally daily (not < 6 y or plasma creatinine > 160 µM/L; regular ocular monitoring) or 30 mg/kg orally 3 times weekly for 2 mo or until known to be susceptible to isoniazid and rifampicin (to 6 mo)

Other Bacteria: guided by culture and susceptibility

Pseudallescheria boydii, Scedosporium: azole

Other Fungi:

Severe: intravitreal amphotericin B + dexamethasone

Less Severe: i.v. fluconazole (not *Aspergillus*) or itraconazole

PANOPHTHALMITIS

Agents: *Bacillus cereus* (in drug abusers), *Pseudomonas aeruginosa*, *Vibrio parahaemolyticus*, *Mycobacterium tuberculosis*

Diagnosis: Gram stain and culture of tissue aspirate, Ziehl-Neelsen stain and culture of tissue

Treatment:

Bacillus cereus: clindamycin

Pseudomonas aeruginosa, Vibrio parahaemolyticus: gentamicin or neomycin topically and injected beneath Tenon's capsule

Mycobacterium tuberculosis: isoniazid 10 mg/kg to 300 mg orally once daily or 15 mg/kg to 600 mg orally 3 times weekly for 6 mo [+ pyridoxine 25 mg (breastfed baby 5 mg) orally with each dose] + rifampicin 10 mg/kg to 600 mg orally once daily 1 h before breakfast or 15 mg/kg to 600 mg orally 3 times a week for 6 mo + pyrazinamide 25-35 mg/kg to 2 g orally once daily or 50 mg/kg to 3 g orally 3 times weekly for 2 mo (6 mo if not known to be susceptible to isoniazid and rifampicin) + ethambutol 15 mg/kg orally daily (not < 6 y or plasma creatinine > 160 µM/L; regular ocular monitoring) or 30 mg/kg orally 3 times weekly for 2 mo or until known to be susceptible to isoniazid and rifampicin (to 6 mo)

PARASITIC EYE INFECTIONS

Agents: *Taenia solium*, *Gnathostoma spinigerum*, *Gnathostoma hispidum*, *Gnathostoma vivarina*, *Parastrongylus cantonesis*, *Loa Loa* (in 5% of infections), *Multiceps* (cysts usually beneath conjunctiva), *Thelazia californiensis*, *Thelazia callipaeda*, *Byalascaris* (from raccoons)

Diagnosis: direct visualisation

***Taenia solium*:** pain on ocular movement, afferent pupillary defect, optic disc oedema; combined vector ultrasonography and magnetic resonance imaging; serum ELISA

***Multiceps*:** poor vision and pain in eye

***Thelazia*:** lacrimation, severe pain, scarring, opacities of conjunctiva; may be nervous symptoms and paralysis of ocular muscles

Treatment

***Taenia solium*:** dexamethasone sodium phosphate 100 mg i.v. daily then oral steroids

Others: surgical removal

BLEPHARITIS: 0.3% of new episodes of illness in UK

Agents: commonly seborrhoeic; also viruses (including varicella-zoster), *Staphylococcus aureus*, coagulase negative staphylococci, Gram negative bacilli, fungi, *Demodex brevis*, *Demodex folliculorum*, *Pediculus humanus*, *Phthirus pubis*

Diagnosis: culture of swab from lid margin, microscopy of epilated eyelashes collected into oil

***Demodex folliculorum*:** usually mild pruritus and fibrous tissue response; rarely, dry chronic erythema with burning irritation and scaling of epidermis

Treatment:

Seborrhoeic: removal of scales from lid margins with 'baby' shampoo or sodium bicarbonate solution; selenium sulphide shampoo of scalp

Varicella-zoster: cool compresses, topical lubrication, broad spectrum antibiotic

Demodex: occlusive ophthalmic ointment to eyelids and eyelashes

***Staphylococcus aureus*:** as for **seborrhoeic** + tetracycline hydrochloride 1% ointment, chloramphenicol 1% ointment, or framycetin 0.5% ointment to lid margins once or twice daily until clinically resolved

Associated with Lid Abscess: flucloxacillin 500 mg orally 6 hourly

Other Bacterial: chloramphenicol 1% + polymyxin B sulphate 5000 U/g ointment to lid margins 3-6 hourly or tetracycline HCl 1% ointment to lid margins 3-6 hourly

Associated with Rosacea: doxycycline 100 mg orally 12 hourly for 2 w, then 100 mg orally daily for 1-2 mo

STYE (EXTERNAL HORDEOLUM): 0.3% of new episodes of illness in UK

Agent: *Staphylococcus aureus*

Diagnosis: pus culture

Treatment: warm compresses, removal of the involved eyelash

MEIBOMIANITIS (INTERNAL HORDEOLUM)

Agents: *Staphylococcus aureus*

Treatment: warm compresses; surgical incision and curettage when necessary; di(flucloxacillin 12.5 mg/kg to 500 mg orally 6 hourly for at least 5 d

Penicillin Hypersensitive: cephalixin 12.5 mg/kg to 500 mg orally 6 hourly for at least 5 d

DACROCYSTITIS, ADENITIS AND CANALICULITIS: 0.04% of new episodes of illness in UK; usually infants or adults > 40 y; unilateral, secondary to blockage of nasolacrimal duct

Agents:

Acute: viruses, *Staphylococcus aureus*, *Streptococcus pyogenes*, *Streptococcus pneumoniae*, *Chlamydia*, *Propionibacterium propionicum* (particularly older males), *Actinomyces*

Chronic: many different bacteria and fungi (especially *Candida albicans*)

Diagnosis: culture and immunofluorescence of canalicular material, conjunctiva

Treatment:

Mild: relief of obstruction, warm compresses; zinc sulphate 0.25% + phenylephrine HCl 0.12% 2 drops 4-8 hourly, with massaging over tear sac before and after instilling drops

Acute and More Severe: di(flu)cloxacillin 12.5 mg/kg to 500 mg orally 6 hourly

Penicillin Hypersensitive: cephalexin 12.5 mg/kg to 500 mg orally 6 hourly

PRESEPTAL (PERIORBITAL) AND POSTSEPTAL (ORBITAL) CELLULITIS

Agents: *Haemophilus influenzae* (< 5 y of age; following URTI; previously usually type b, now more commonly non-type b; preseptal and postseptal), *Staphylococcus aureus* (postseptal), *Streptococcus pyogenes* (secondary to puncture wounds or lacerations), *Streptococcus pneumoniae* (preseptal and postseptal), aerobic Gram negative bacilli (postseptal), anaerobes (due to trauma, especially human or animal bites; also dental procedures; postseptal), *Pseudomonas aeruginosa*, *Mucor* and *Aspergillus* (postseptal; immunosuppressed; sinusitis spreading to orbit)

Diagnosis: cultures of swabs of conjunctivae and nearby skin lesions, sinus drainage, abscess drainage or biopsy; blood cultures; sinus and orbital X-rays; CT scanning and ultrasound; lumbar puncture to exclude meningitis

Preseptal: pain, redness, oedema of eyelid, low grade fever, inflamed and purulent conjunctiva

Postseptal: fever, headache, swelling of globe, proptosis, marked chemosis, pain on eye movement and compromised eye movement

Treatment:

Bacterial:

Preseptal:

< 5 y:

Child Well: amoxicillin/clavulanate 22.5/3.2 mg/kg to 875/125 mg orally

12

hourly for 7 d or cephalexin 12.5 mg/kg to 500 mg orally 6 hourly for 7 d

Severely Ill Child: cefotaxime 50 mg/kg to 2 g i.v. 8 hourly or ceftriaxone

50

mg/kg to 2 g i.v. once daily or cefuroxime or ampicillin-sulbactam until response, then amoxicillin-clavulanate 22.5/3.2 mg/kg to 875/125 mg orally 12 hourly for total duration of 7 d; if stye, dacryocystitis, impetigo or wound present, add di/flucloxacillin as below

> 5 y: di(flu)cloxacillin 12.5 mg/kg to 500 mg orally 6 hourly for 7 d or 50 mg/kg to 2 g i.v. 6 hourly for at least 14 d if severe

Postseptal: drainage of abscesses/sinuses; di(flu)cloxacillin 50 mg/kg to 2 g i.v. 6 hourly + ceftriaxone 50 mg/kg to 2 g i.v. once daily or cefotaxime 50 mg/kg to 2 g i.v. 8 hourly, then amoxicillin/clavulanate 22.5/3.2 mg/kg to 875/125 mg orally 12 hourly for further 10 d; + 2 antipseudomonal antibiotics in neutropenics

Fungi: amphotericin B + flucytosine

OCULAR MYIASIS (OPHTHALMOMYIASIS, OPHTHALMOMYIASIS EXTERNA, OPHTHALMOMYIASIS INTERNA

ANTERIOR, OPHTHALMOMYIASIS INTERNA POSTERIOR): infestation of eye or surrounding tissues by larvae of certain flies

Agents: *Cochliomyia hominivorax*, *Cochliomyia macellaria*, *Chrysomya bezziana*, *Chrysomya megacephala*, *Gasterophilus intestinalis*, *Hypoderma bovis*, *Hypoderma lineatum*, *Oestrus ovis*, *Rhinoestrus purpureus*, *Wohlfahrtia magnifica*

Diagnosis: usually painful conjunctivitis but larvae may also penetrate cornea or reach into tissues of eye, producing serious damage; direct visualisation

Treatment: removal or destruction of larvae if alive; appropriate management of any sequelae