

## Ophthalmological preparations

## Administration of eye preparations

Preparations for the eye should be sterile when issued. Use of single-application containers is preferable; multiple-application preparations include antimicrobial preservatives and when used particular care should be taken to prevent contamination of the contents, including the avoidance of contact between the applicator and the eye or other surfaces.

Eye drops are generally instilled into the lower conjunctival sac which is accessed by gently pulling down the lower eyelid to form a pocket into which one drop is instilled. The eye should be kept closed for as long as possible after application, preferably 1–2 minutes. A small amount of eye ointment is applied similarly; the ointment melts rapidly and blinking helps to spread it.

When two different eye drops are required at the same time, dilution and overflow may occur when one immediately follows the other; an interval of 5 minutes should be allowed between the two applications.

Systemic absorption, which may occur after topical application of eye drops, can be minimized by using the finger to compress the lacrimal sac at the medial canthus for at least one minute after instillation of the drops. This helps block the passage of the drops through the naso-lacrimal duct.

### PERFORMANCE OF SKILLED TASKS

Application of eye preparations may cause blurring of vision which is generally transient; patients should be advised not to carry out skilled tasks such as operating machinery or driving until their vision has cleared.

## Anti-infective drugs

Blepharitis, conjunctivitis, keratitis and endophthalmitis are common acute infections of the eye and can be treated topically. However, in some cases, for example, in gonococcal conjunctivitis, both topical and systemic anti-infective treatment may be necessary. Blepharitis and conjunctivitis are often caused by staphylococcus, while keratitis and endophthalmitis may be bacterial, viral or fungal. Bacterial blepharitis is treated with an antibacterial eye ointment or drops. Although most cases of acute bacterial conjunctivitis may resolve spontaneously, anti-infective treatment shortens the infectious process and prevents complications. Acute infective conjunctivitis is treated with antibacterial eye drops by day and eye ointment applied at night. A poor response may indicate viral or allergic conjunctivitis. Keratitis requires immediate specialist treatment.

**Gentamicin** is a broad-spectrum bactericidal aminoglycoside antibiotic with particular activity against *Pseudomonas aeruginosa*, *Neisseria gonorrhoea* and other bacteria that may be implicated in blepharitis or conjunctivitis. Topical application may lead to systemic absorption and possible adverse effects.

**Idoxuridine** is an antiviral used in the treatment of keratitis due to herpes simplex virus. Idoxuridine is effective against epithelial infections of recent origin. These may respond to treatment within a week and resolve completely in 1–2 weeks. Eye drops must be applied frequently to maintain a high concentration and achieve a successful therapeutic outcome; however, if there is no relief within 7 days, treatment should be discontinued and alternative treatment is indicated. For systemic treatment with antivirals such as aciclovir, see section 6.5.1.

**Silver nitrate** is a topical anti-infective. Its antibacterial activity is attributed to precipitation of bacterial proteins by silver ions. It is available in 1% ophthalmic solutions and is used for prophylaxis of gonococcal ophthalmia neonatorum.

**Tetracycline** is a broad spectrum antibiotic with activity against many Gram-positive and Gram-negative bacteria including *N. gonorrhoea*, and most chlamydia, rickettsia, mycoplasma and spirochetes. Ophthalmic tetracycline is used in blepharitis, conjunctivitis, and keratitis produced by susceptible bacteria. Tetracycline is also used in the treatment of trachoma caused by *Chlamydia trachomatis* and in the prophylaxis of neonatal conjunctivitis (ophthalmia neonatorum) caused by *N. gonorrhoea* and *C. trachomatis*.

### **Gentamicin**

Gentamicin is a representative antibacterial. Various drugs can serve as alternatives

*Eye drops, solution, gentamicin (as sulfate) 0.3%*

#### **Uses:**

blepharitis; bacterial conjunctivitis; systemic infections (section 6.2.2.5)

#### **Contraindications:**

hypersensitivity to aminoglycoside group of antibiotics

#### **Precautions:**

prolonged use may lead to skin sensitization and emergence of resistant organisms including fungi; discontinue if purulent discharge, inflammation or exacerbation of pain

#### **Administration:**

Mild to moderate infection, *by instillation into the eye*, **ADULT** and **CHILD** 1 drop every 2 hours, reducing frequency as infection is controlled, then continue for 48 hours after healing is complete

Severe infection, *by instillation into the eye*, **ADULT** and **CHILD** 1 drop every hour, reducing frequency as infection is controlled, then continue for 48 hours after healing is complete

**Adverse effects:**

burning, stinging, itching, dermatitis

**Iodoxuridine**

Iodoxuridine is a representative antiviral. Various drugs can serve as alternatives

*Eye drops, solution, idoxuridine 0.1%*

*Eye ointment, idoxuridine 0.2%*

**Uses:**

keratitis or keratoconjunctivitis caused by herpes simplex

**Contraindications:**

pregnancy; concurrent use of an eye preparation containing boric acid

**Precautions:**

existing deep ulceration of cornea; prolonged or excessive use may damage the cornea; do not exceed frequency or duration of treatment, discontinue if no relief within 7 days; concurrent use of a corticosteroid

**Administration:**

Herpes simplex keratitis, *by instillation into the eye*, **ADULT** and **CHILD** 1 drop every hour during daytime and every 2 hours at night-time, reducing frequency as infection is controlled to 1 drop every 2 hours during daytime and every 4 hours at night-time, then continue for 3–5 days after healing is complete; maximum length of treatment 21 days

Herpes simplex keratitis, *by application to the eye*, **ADULT** and **CHILD** 1 application of ointment every 4 hours during daytime and once at night-time (5 applications), then continue for 3–5 days after healing is complete; maximum length of treatment 21 days

**Adverse effects:**

occasionally burning, itching, irritation, pain, conjunctivitis, oedema, inflammation, photophobia, pruritus; rarely allergic reactions

**Silver nitrate**

*Eye drops, solution, silver nitrate 1%*

**Uses:**

prophylaxis of neonatal conjunctivitis (ophthalmia neonatorum) due to *Neisseria gonorrhoea* , if tetracycline not available

**Precautions:**

avoid use of old, concentrated drops; wipe excess drops from skin near the eye to prevent staining

**Administration:**

Prophylaxis of neonatal conjunctivitis, *by instillation into the eye* , **NEWBORN** at birth after cleansing eyes with sterile gauze, 2 drops into each eye

**Adverse effects:**

skin and mucous membrane irritation; mild conjunctivitis; repeated use may cause skin discoloration, corneal cauterization and blindness

**Tetracycline hydrochloride**

Tetracycline is a representative antibacterial. Various drugs can serve as alternatives

*Eye ointment*, tetracycline hydrochloride 1%

**Uses:**

superficial bacterial infection of the eye; mass treatment of trachoma in endemic areas; prophylaxis of neonatal conjunctivitis (ophthalmia neonatorum) due to *Neisseria gonorrhoea* or *Chlamydia trachomatis*

**Contraindications:**

hypersensitivity to tetracycline group of antibiotics

**Precautions:**

prolonged use may lead to overgrowth of non-susceptible organisms

**Administration:**

Superficial bacterial infection, *by application to the eye*, **ADULT** and **CHILD** aged over 8 years 1 application of ointment 3–4 times daily

Prophylaxis of neonatal conjunctivitis, *by application to the eye* , **NEWBORN** at birth after cleansing eyes with sterile gauze, 1 application of ointment into each eye; close eyelids and massage gently to aid spread of ointment

Trachoma, intermittent treatment, *by application to the eye*, **ADULT** and **CHILD** 1 application of ointment into each eye *either* twice daily for 5 days *or* once daily for 10 days, every month for 6 consecutive months each year, repeated as necessary

Trachoma, continuous intensive treatment, *by application to the eye*, **ADULT** and **CHILD** 1 application of ointment into each eye twice daily for at least 6 weeks

**Adverse effects:**

rash; rarely stinging, burning

**Anti-inflammatory drugs**

Ophthalmic corticosteroids should only be used under supervision of an ophthalmologist as inappropriate use is potentially blinding. Dangers include the development of open-angle glaucoma (chronic simple glaucoma) and cataracts, and the aggravation of a simple herpes simplex epithelial lesion into an extensive corneal ulcer and subsequent permanent corneal scarring, with possible damage to vision and even loss of the eye.

Corticosteroids such as **prednisolone** are useful in the treatment of inflammatory conditions including uveitis and scleritis. They are also used for reducing postoperative ocular inflammation. Before administration of an ophthalmic corticosteroid, the possibility of bacterial, viral or fungal infection should be excluded. Treatment should be the lowest effective dose for the shortest possible time; if long-term therapy (more than 6 weeks) is unavoidable, withdrawal of an ophthalmic corticosteroid should be gradual to avoid relapse.

**Prednisolone sodium phosphate**

Prednisolone is a representative corticosteroid. Various drugs can serve as alternatives

*Eye drops , solution , prednisolone sodium phosphate 0.5%*

**Uses:**

short-term local treatment of inflammation of the eye; malignant disease (section 8.3); inflammatory and allergic reactions (section 18.1, also section 3.1)

**Contraindications:**

undiagnosed 'red eye' caused by herpetic keratitis; glaucoma

**Precautions:**

cataract; corneal thinning, corneal or conjunctival infection; discontinue treatment if no improvement within 7 days; risk of adrenal suppression after prolonged use in infants

**Administration:**

*NOTE.* Use only under the supervision of an ophthalmologist

Inflammation of the eye, *by instillation into the eye* , **ADULT** and **CHILD** 1 drop every 1–2 hours, reducing frequency as inflammation is controlled

**Adverse effects:**

secondary ocular infection; impaired corneal healing (due to corneal thinning), optic nerve damage, cataract; glaucoma, mydriasis, ptosis, epithelial punctate keratitis, delayed hypersensitivity reactions including burning, stinging

**Local anaesthetics**

Topical local anaesthetics are employed for simple ophthalmological procedures and for short operative procedures involving the cornea and conjunctiva. **Tetracaine** , available in 0.5% ophthalmic solution, provides a rapid local anaesthesia which lasts for 15 minutes or more. Prolonged or unsupervised use of tetracaine is not recommended.

**Tetracaine hydrochloride**

Amethocaine

Tetracaine is a representative local anaesthetic. Various drugs can serve as alternatives

*Eye drops , solution , tetracaine hydrochloride 0.5%*

**Uses:**

short-acting local anaesthesia of cornea and conjunctiva

**Contraindications:**

hypersensitivity to ester-type local anaesthetics; eye inflammation or infection

**Precautions:**

avoid prolonged use (cause of severe keratitis, permanent corneal opacification, scarring, delayed corneal healing); protect eye from dust and bacterial contamination until sensation fully restored

**Administration:**

Local anaesthesia, *by instillation into the eye* , **ADULT** and **CHILD** 1 drop

**Adverse effects:**

burning, stinging, redness; rarely, allergic reactions may occur

## Antiglaucoma drugs

Glaucoma is normally associated with raised intra-ocular pressure and eventual damage to the optic nerve which may result in blindness. The rise in pressure is almost always due to reduced outflow of aqueous humour, the inflow remaining constant. The most common condition is chronic open-angle glaucoma (chronic simple glaucoma) in which the intra-ocular pressure increases gradually and the condition is usually asymptomatic until well advanced. In contrast, angle-closure glaucoma (closed-angle glaucoma) usually occurs as an acute emergency resulting from a rapid rise in intra-ocular pressure; if treatment is delayed, chronic angle-closure glaucoma may develop. Ocular hypertension is a condition in which intra-ocular pressure is raised without signs of optic nerve damage.

Drugs used in the treatment of glaucoma lower the intra-ocular pressure by a variety of mechanisms including reduction in secretion of aqueous humour by the ciliary body, or increasing the outflow of the aqueous humour by opening of the trabecular network. Antiglaucoma drugs used include topical application of a beta-blocker (beta-adrenoceptor antagonist), a miotic, or a sympathomimetic such as epinephrine; systemic administration of a carbonic anhydrase inhibitor may be used as an adjunct.

**Timolol** is a non-selective beta-blocker that reduces the secretion of aqueous humour. A beta-blocker is usually the drug of choice for initial and maintenance treatment of chronic open-angle glaucoma. If further reduction in intra-ocular pressure is required a miotic, a sympathomimetic or a systemic carbonic anhydrase inhibitor may be used with timolol. In angle-closure glaucoma, timolol should be used with a miotic and not alone. Since systemic absorption can occur, an ophthalmic beta-blocker should be used with caution in certain individuals.

A miotic such as **pilocarpine**, through its parasympathomimetic action, contracts the iris sphincter muscle and the ciliary muscle, and opens the trabecular network. It is used in chronic open-angle glaucoma either alone or, if required, with a beta-blocker, epinephrine or a systemic carbonic anhydrase inhibitor. Pilocarpine is used with systemic acetazolamide in an acute attack of angle-closure glaucoma prior to surgery; however, it is not advisable to use pilocarpine after surgery because of a risk of posterior synechiae forming. Systemic absorption of topically applied pilocarpine can occur producing muscarinic adverse effects.

The sympathomimetic drug **epinephrine** (adrenaline) probably acts by reducing the rate of production of aqueous humour and increasing the outflow through the trabecular network. Epinephrine is usually used with a miotic, a beta-blocker or a systemic carbonic anhydrase inhibitor in the treatment of chronic open-angle glaucoma; however, because epinephrine is also a mydriatic, it is contraindicated for angle-closure glaucoma unless an iridectomy has been carried out.

**Acetazolamide**, by reducing carbonic anhydrase in the eye, reduces the production of aqueous humour and so reduces intra-ocular pressure. It is used systemically as an adjunct in chronic open-angle glaucoma unresponsive to treatment with topically applied antiglaucoma drugs. Prolonged therapy with acetazolamide is not normally recommended, but if treatment is unavoidable blood count and plasma electrolyte concentration should be monitored. Acetazolamide is also used as part of emergency

treatment for an acute attack of angle-closure glaucoma; however it should not be used in chronic angle-closure glaucoma as it may mask deterioration of the condition.

## Miotics

### Pilocarpine

Pilocarpine is a representative miotic. Various drugs can serve as alternatives

*Eye drops , solution , pilocarpine hydrochloride 2%, 4%; pilocarpine nitrate 2%, 4%*

#### Uses:

chronic open-angle glaucoma, ocular hypertension; emergency treatment of acute angle-closure glaucoma; to antagonize effects of mydriasis and cycloplegia following surgery or ophthalmoscopic examination

#### Contraindications:

acute iritis, acute uveitis, anterior uveitis, some forms of secondary glaucoma; acute inflammation of anterior segment; not advisable after angle-closure surgery (risk of posterior synechiae)

#### Precautions:

retinal disease, conjunctival or corneal damage; monitor intra-ocular pressure in chronic open-angle glaucoma and in long-term treatment; cardiac disease, hypertension, asthma, peptic ulceration, urinary-tract obstruction, Parkinson disease; stop treatment if symptoms of systemic toxicity develop

*Skilled tasks.* Causes difficulty with dark adaptation; may cause accommodation spasm. Do not carry out skilled tasks, for example operating machinery or driving until vision is clear

#### Administration:

Chronic open-angle glaucoma, *by instillation into the eye* , **ADULT** 1 drop (2% or 4%) up to 4 times daily

Acute angle-closure glaucoma before surgery, *by instillation into the eye* , **ADULT** 1 drop (2%) every 10 minutes for 30–60 minutes, then 1 drop every 1–3 hours until intra-ocular pressure subsides

#### Adverse effects:

eye pain, blurred vision, ciliary spasm, lacrimation, myopia, browache; conjunctival vascular congestion, superficial keratitis, vitreous haemorrhage and increased pupillary block have been reported; lens opacities have occurred following prolonged use; rarely systemic effects including hypertension, tachycardia, bronchial spasm, pulmonary oedema, salivation, sweating, nausea, vomiting, diarrhoea

## Beta-blockers

### Timolol

Timolol is a representative beta-blocker. Various drugs can serve as alternatives

*Eye drops , solution , timolol (as maleate) 0.25%, 0.5%*

#### **Uses:**

ocular hypertension; chronic open-angle glaucoma, aphakic glaucoma, some secondary glaucomas

#### **Contraindications:**

uncontrolled heart failure, bradycardia, heart block; asthma, obstructive airways disease

#### **Precautions:**

older people (risk of keratitis); if used in angle-closure glaucoma, use with a miotic, and not alone; **interactions:** Appendix 1

#### **Administration:**

Ocular hypertension, chronic open-angle glaucoma, aphakic glaucoma, some secondary glaucomas, *by instillation into the eye* , **ADULT** 1 drop (0.25% or 0.5%) twice daily

#### **Adverse effects:**

stinging, burning, pain, itching, erythema, transient dryness, allergic blepharitis, transient conjunctivitis, keratitis, decreased corneal sensitivity, diplopia, ptosis; systemic effects, particularly on the pulmonary, cardiovascular and central nervous systems, may follow absorption

## Sympathomimetics

### Epinephrine (adrenaline)

Epinephrine is a complementary drug for use when drugs in the main list cannot be made available

*Eye drops, solution , epinephrine (as hydrochloride) 0.5%, 1%*

#### **Uses:**

chronic open-angle glaucoma, ocular hypertension; anaphylaxis (section 3.1); cardiac arrest (section 12.2)

**Contraindications:**

angle-closure glaucoma, unless an iridectomy has been carried out

**Precautions:**

hypertension, heart disease, aneurysm, arrhythmia, tachycardia, hyperthyroidism, cerebral arteriosclerosis, diabetes mellitus

**Administration:**

Chronic open-angle glaucoma, *by instillation into the eye* , **ADULT** 1 drop (0.5% or 1%) 1–2 times daily

**Adverse effects:**

stinging, blurred vision, photophobia, eye pain, conjunctival hyperaemia, headache or browache; occasionally, conjunctival sensitization and local skin reactions; after prolonged use conjunctival pigmentation and macular oedema in aphakia; systemic adverse reactions are rare following topical use at normal dosage but tachycardia, hypertension, arrhythmia, dizziness, sweating may occur

**Carbonic anhydrase inhibitors****Acetazolamide**

*Tablets*, acetazolamide 250 mg

**Uses:**

as an adjunct in the treatment of chronic open-angle glaucoma; secondary glaucoma; as part of pre-operative treatment of acute angle-closure glaucoma

**Contraindications:**

hypersensitivity to sulfonamides; chronic angle-closure glaucoma (may mask deterioration); hypokalaemia, hyponatraemia, hyperchloraemic acidosis; renal impairment (Appendix 4), severe hepatic impairment

**Precautions:**

elderly; pregnancy (Appendix 2); breastfeeding (Appendix 3); diabetes mellitus; pulmonary obstruction; monitor blood count and electrolytes if used for long periods;

**interactions:** Appendix 1

*Skilled tasks.* May impair ability to perform skilled tasks, for example operating machinery, driving

**Dosage:**

Chronic open-angle glaucoma, secondary glaucoma, *by mouth* , **ADULT** 0.25–1 g daily in divided doses

**Adverse effects:**

nausea, vomiting, diarrhoea, taste disturbance; loss of appetite, paraesthesia, flushing, headache, dizziness, fatigue, irritability, depression; thirst, polyuria; reduced libido; metabolic acidosis and electrolyte disturbances on long-term therapy; occasionally drowsiness, confusion, hearing disturbances, urticaria, melaena, glycosuria, haematuria, abnormal liver function, renal calculi, blood disorders including agranulocytosis and thrombocytopenia, rashes including Stevens-Johnson syndrome and toxic epidermal necrolysis; transient myopia reported

**Mydriatics and cycloplegics**

Antimuscarinics, by blocking the cholinergic effects of acetylcholine, paralyse the pupillary constrictor muscles causing dilation of the pupil (mydriasis) and paralyse the ciliary muscles resulting in paralysis of accommodation (cycloplegia). Mydriasis may precipitate acute angle-closure glaucoma particularly in elderly or long-sighted patients. In patients with dark iridic pigmentation, higher concentrations of mydriatic drugs are usually required and care should be taken to avoid overdosing.

**Atropine** is a long-acting antimuscarinic used for cycloplegic refraction procedures, particularly in children. It is also used to immobilize the ciliary muscle and iris and to prevent formation of posterior synechiae in the treatment of inflammatory eye disorders such as iritis and uveitis.

**Atropine sulfate**

*Eye drops , solution* , atropine sulfate 0.1%, 0.5%, 1%

**Uses:**

iritis, uveitis; cycloplegic refraction procedures; premedication (section 1.3); organophosphate poisoning (section 4.2.3); antispasmodic (section 17.5)

**Contraindications:**

angle-closure glaucoma

**Precautions:**

may precipitate acute attack of angle-closure glaucoma, particularly in the elderly or long-sighted; risk of systemic effects with eye drops in infants under 3 months—eye ointment preferred

*Skilled tasks.* May cause sensitivity to light and blurred vision. Do not carry out skilled tasks, for example operating machinery or driving, until vision is clear

**Administration:**

Cycloplegic refraction, *by instillation into the eye* , **ADULT** 1 drop (1%) twice daily for 1–2 days before procedure *or* a single application of 1 drop (1%) 1 hour before procedure; **CHILD** under 3 months (see Precautions), 3 months–1 year (0.1%), 1–5 years (0.1–0.5%), over 5 years (0.5–1%), 1 drop twice daily for 1–3 days before procedure with a further dose given 1 hour before procedure

Iritis, uveitis, *by instillation into the eye* , **ADULT** 1 drop (0.5 or 1%) up to 4 times daily; **CHILD** 1 drop (0.5 or 1%) up to 3 times daily

**Adverse effects:**

transient stinging and raised intra-ocular pressure; on prolonged administration, local irritation, hyperaemia, oedema and conjunctivitis may occur; contact dermatitis; systemic toxicity may occur in the very young and the elderly