

Decoding the red eye

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Red eye, or hyperaemia, is one of the most common presentations to primary care [1] and the emergency department [2]. However, despite this the underlying cause is often misdiagnosed which can lead to severe, sight-threatening conditions being missed [1]. Thorough evaluation with an appropriate history and examination can help to distinguish the sight-threatening from the benign red eye. In this article, we aim to discuss common causes of red eye and provide a comprehensive approach to decoding the red eye.

What are the causes?

Redness of the eye can be unilateral or bilateral. It is the primary sign of ocular inflammation usually occurring due to engorgement of superficial blood vessels or can occur when a blood vessel ruptures [3]. Most of the cases tend to be benign as they are self-limiting or require minimal intervention. Only a handful of cases go on to be serious and in need of urgent referral.

There are a myriad of causes that lead to a red eye. The following is a red eye sieve to help consider the possible differential diagnoses [4]:

INFECTION	Keratitis / Corneal ulcer (bacterial or viral) Conjunctivitis (bacterial, viral, chlamydial or gonococcal) Endophthalmitis (endogenous or exogenous)
ALLERGY	Allergic conjunctivitis
TRAUMA	Corneal abrasion Foreign body Chemical injury Subconjunctival haemorrhage
INFLAMMATION	Scleritis Episcleritis Marginal keratitis Iritis Uveitis Blepharitis
RAISED INTRAOCULAR PRESSURE	Acute angle closure
OTHER	Dry eye

History and examination

As with all presentations, good history and examination is key to an accurate diagnosis and initiation of appropriate management. A thorough history is essential as the presence of a red eye may be associated with an underlying systemic disease. Therefore, a complete history including a systems review, past medical, drug, family and social history is necessary.

In order to determine the underlying cause for the red eye, there are two key questions to ask in the history of the presenting complaint:

1) Is there any pain?

2) Is there any loss of vision?

Other important features to enquire about include whether the symptoms are unilateral or bilateral, the duration of symptoms, presence of photophobia, recent eye trauma or surgery, contact with anyone unwell, whether there is a history of contact lens use and, if so, contact lens hygiene.

A stepwise examination approach incorporates a thorough inspection of the structures of the eye as well as eye function [5,6].

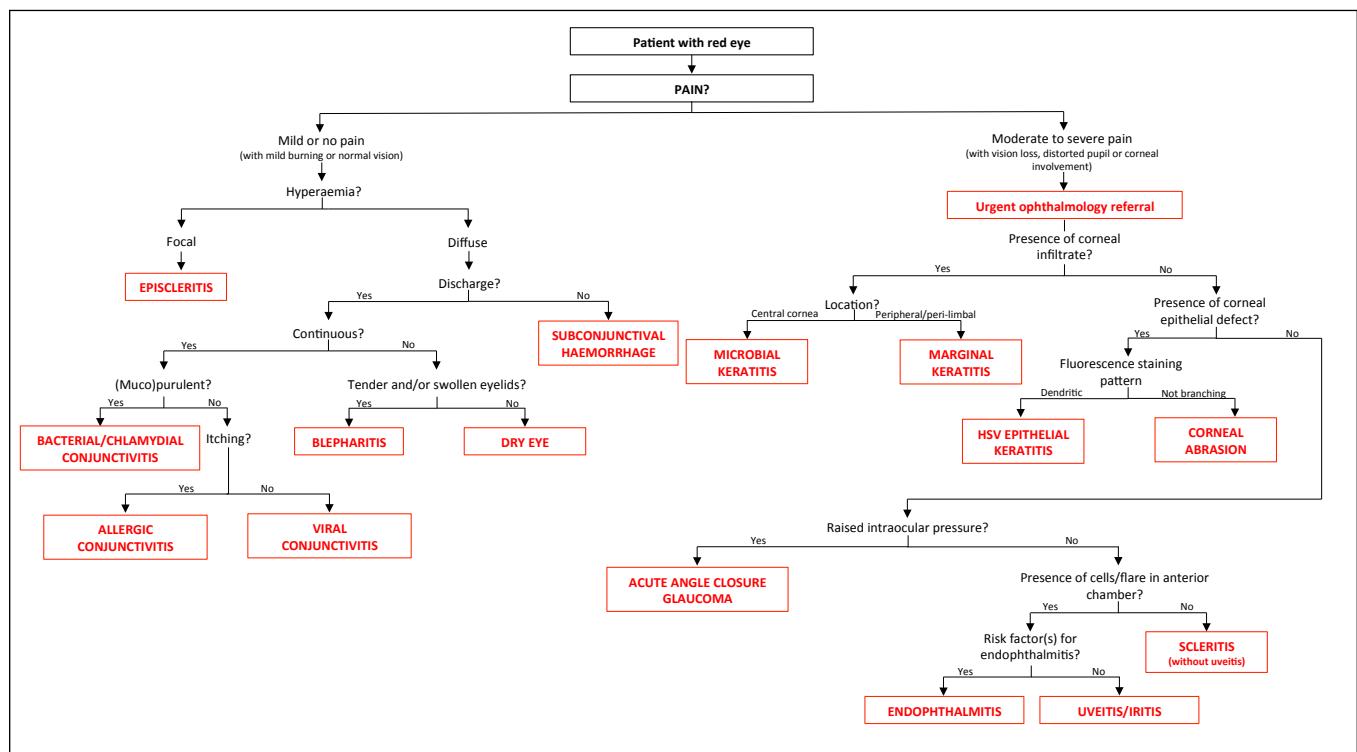
VISUAL ACUITY	Visual acuity can be assessed using a Snellen chart. In addition to monocular assessment of vision with occlusion, pinhole assessment should be completed to check for any refractive error. Reduced visual acuity may be suggestive of a serious underlying cause and may warrant urgent ophthalmology referral.
PUPILS	The pupils should be assessed for symmetry on general inspection. Asymmetry may be noted in cases of uveitis or acute angle closure, in the context of the red eye. This should be followed by an assessment of the direct, consensual and accommodative response. Furthermore, a relative afferent pupillary defect test can be completed if optic nerve pathology is suspected.
EXTERNAL EYE	The eyelids should be assessed for symmetry and the presence of any lumps, trauma, oedema, cellulitis, entropion, ectropion or blockage of the Meibomian glands at the eyelid margins. Any trichiasis of the eyelashes or orbital inflammation / infection should also be noted.
CONJUNCTIVA	Conjunctival examination includes assessment of the bulbar and tarsal conjunctiva and the conjunctival fornices. The upper lid can be everted using a cotton bud to reveal the upper tarsal conjunctiva. This is crucial, especially if a foreign body is suspected. Any follicles or papillae should also be noted as it may indicate aetiology in cases of conjunctivitis. Presence and description of any conjunctival discharge will support the diagnosis further. Conjunctival swabs should be taken if the diagnosis is unclear. Distribution and severity of injection can aid diagnosis, e.g. localised injection is more suggestive of an episcleritis.
CORNEA	Corneal examination should assess the clarity of the corneal layers. Findings can include corneal foreign bodies, corneal epithelial defects, corneal infiltrate, corneal scarring, corneal oedema, keratic precipitates (inflammatory cell deposition on the corneal endothelium) and irregular corneal light reflection (local disruption of the corneal epithelium). Fluorescein dye can be used to observe any disruption of the corneal epithelium, for example secondary to corneal abrasion or corneal ulcer, using the cobalt blue filter on the slit lamp.
ANTERIOR CHAMBER	Anterior chamber examination may show the presence of inflammatory cells, for example in cases of uveitis. Other findings include the accumulation of blood (hyphaema) or pus (hypopyon), which may be suggestive of trauma and infection respectively. It is important to note the extent of activity in cases of inflammation and measure the height of the hyphaema or hypopyon, as this will help to assess the response to treatment at follow-up.
INTRAOCULAR PRESSURE	An elevated intraocular pressure can support the diagnosis of acute angle closure. Elevated intraocular pressure may also be noted in the context of ocular inflammation or in response to steroid treatment.
FUNDUS EXAMINATION	Fundus examination may not be warranted in many cases of red eye. However, in cases such as uveitis, scleritis, trauma or endophthalmitis, it is crucial to assess the vitreous and retina for posterior segment involvement, as it will affect the management of the condition.

Red flags [7]

NICE recommends considering a same day ophthalmology referral if the following features are present, as they may be indicative of serious underlying pathology:

- Reduced vision or visual acuity
- Deep pain in the eye or tenderness on palpation of the globe
- Photophobia
- Unequal pupil or abnormal pupil reactions
- High velocity or chemical injury
- Contact lens use
- Fluorescein staining
- Neonatal conjunctivitis – conjunctivitis in the infant in the first 28 days of life

Diagnosing the red eye [8,9]



The acute non-painful red eye [10,11]

CONDITION	DIFFERENTIATING FACTORS	TREATMENT AND REFERRAL URGENCY
Bacterial conjunctivitis (<i>Staphylococcus epidermidis</i> , <i>staphylococcus aureus</i> , <i>streptococcus pneumoniae</i>)	Signs and symptoms: (Muco)purulent sticky discharge; crusted lids	<ul style="list-style-type: none"> Conjunctival swabs for culture / sensitivities Topical chloramphenicol for seven days General hygiene advice: frequent handwashing, no sharing towels Refer if condition worsens or persists after seven to ten days of treatment
Viral conjunctivitis (<i>Adenovirus</i>)	Symptoms: History of contact with person with similar symptoms; gritty sensation; itching Signs: Tender preauricular lymphadenopathy; watery discharge that characteristically spreads to other eye; palpebral conjunctival follicles	<ul style="list-style-type: none"> Conjunctival swab for viral antigen testing or PCR Cool compresses and artificial tears General hygiene advice: frequent handwashing, no sharing towels +/- Topical chloramphenicol Refer if condition worsens or persists after seven to ten days of treatment
Chlamydial conjunctivitis (<i>Chlamydia trachomatis</i>)	Symptoms: Associated sexual history; systemic features Signs: Non-tender periauricular lymphadenopathy; unilateral involvement; mucopurulent persistent discharge; lid oedema; palpebral conjunctival follicles	<ul style="list-style-type: none"> Refer to ophthalmology for assessment and management Conjunctival swabs for immunofluorescent staining, cell culture, PCR, ELISA Topical chloramphenicol; oral azithromycin 1g stat or doxycycline 100mg for seven days Refer for contact tracing to GUM clinic
Ophthalmia neonatorum (Neonatal chlamydial conjunctivitis)	Mucopurulent discharge within 28 days of birth	<ul style="list-style-type: none"> Refer to ophthalmology for assessment and management Conjunctival scrapings for Giemsa stain; erythromycin for two weeks; refer mother for counselling and to GUM clinic
Gonorrhoeal conjunctivitis (<i>Neisseria gonorrhoeae</i>)	Symptoms: Hyperacute onset (<24 hours); associated sexual history; systemic features Signs: Non tender periauricular lymphadenopathy; severe purulent discharge; lid oedema; papillae +/- keratitis	<ul style="list-style-type: none"> Refer to ophthalmology for assessment and management Conjunctival swabs for Gram stain, culture + sensitivities GUM clinic referral for assessment, treatment and contact tracing Topical ofloxacin; if with keratitis: + IV 1g ceftriaxone for three days
Allergic conjunctivitis	Symptoms: Itching; history of atopy Signs: Bilateral involvement; lid oedema; palpebral conjunctival papillae; watery discharge; severe chemosis	<ul style="list-style-type: none"> Conjunctival swabs; skin prick testing; serum IgE Identify and eliminate allergen Ocular lubricants +/- topical antihistamines +/- oral antihistamine If severe, consider mild topical steroid Refer to ophthalmology in cases of severe allergic conjunctivitis, requiring steroid treatment
Episcleritis (Inflammation of the episclera)	Symptoms: Sudden onset of mild discomfort Signs: Lacrimation; localised area of conjunctival inflammation/ redness which blanches with topical vasoconstrictor (e.g. phenylephrine); occasionally a nodule is present	<ul style="list-style-type: none"> Usually self-limiting Provide reassurance; topical lubricants; topical NSAIDS are sometimes required if symptoms persist Refer to ophthalmology if no response to initial treatment measures
Subconjunctival haemorrhage (Bleeding underneath conjunctiva)	Symptoms: Usually asymptomatic Signs: Absence of discharge; localised area of subconjunctival blood that is relatively well demarcated	<ul style="list-style-type: none"> Check blood pressure Usually self-limiting if no other abnormalities Refer to ophthalmology if history of trauma or recurrent episodes
Blepharitis (Inflammation of lid margin)	Symptoms: Persistently sore eyes; gritty sensation Signs: Inflammation and crusting of lid margin / eyelid; presence of stye or chalazion	<ul style="list-style-type: none"> Warm compress and effective lid hygiene Artificial tears +/- Topical antibiotics Refer to ophthalmology if severe symptoms or corneal involvement – topical steroids and prolonged course of oral antibiotics may be considered in these cases
Keratoconjunctivitis sicca (Dry eyes)	Symptoms: Common in elderly; chronic gritty sensation; burning; history of Sjögren's syndrome; anticholinergic use Signs: Punctate epitheliopathy; Tear film break up time < 10s; mucus strands	<ul style="list-style-type: none"> Schirmer test <5mm over five minutes Extensive Rose Bengal staining due to damage of ocular tear film Artificial tear drops Refer to ophthalmologist if symptoms persist to consider punctal occlusion

The acute painful red eye [10,11]

CONDITION	DIFFERENTIATING FACTORS	TREATMENT AND REFERRAL URGENCY
Corneal abrasion (Corneal epithelial defect as a result of injury)	Symptoms: Severe pain and distress; photophobia +/- reduced vision Signs: Reduced visual acuity; lacrimation; corneal epithelial defect	<ul style="list-style-type: none"> Abrasions may be missed if fluorescein is not instilled. Topical chloramphenicol is advised until the epithelial defect heals +/-. topical cycloplegic drops if severe pain reported; +/- oral analgesia Refer to ophthalmology if symptoms do not resolve within 48 hours; vision is impaired, secondary infection or purulent discharge present
Microbial keratitis Bacterial: <i>Pseudomonas</i> (most commonly contact lens associated), <i>Staphylococcus</i> Fungal: <i>Candida</i> (yeast-like), <i>Fusarium</i> (filamentous), <i>Aspergillus</i> (filamentous)	Bacterial keratitis risk factors: Contact lens wear and poor hygiene, ocular trauma, ocular surgery, immunocompromised, topical steroid use Fungal keratitis risk factors: Secondary to trauma involving organic material Symptoms: Moderate-severe unilateral pain; acute onset; rapid progression; photophobia +/- reduced vision Signs: Reduced visual acuity, corneal infiltrate +/- epithelial defect; +/- anterior chamber inflammation	<ul style="list-style-type: none"> Emergency ophthalmology referral Culture of contact lens +/- solution Corneal scrape for culture and sensitivities Bacteria: Topical ofloxacin; If severe: Fortified cefuroxime + gentamicin Fungal: Filamentous: topical natamycin; Yeast: topical amphotericin
Marginal keratitis (Inflammation of peripheral cornea due to hypersensitivity to staphylococcal exotoxins)	Risk factors: Staphylococcal blepharitis, rosacea, history of atopy Symptoms: Increasing pain; foreign body sensation; photophobia Signs: Reduced visual acuity; lacrimation; epithelial defect stains with fluorescein; sterile white sub-epithelial peripheral corneal infiltrate adjacent to limbus but separated from limbus by an interval of clear cornea	<ul style="list-style-type: none"> Refer to ophthalmology for diagnosis and management Treatment options: 1) Topical maxitrol or 2) Topical predsol and topical chloramphenicol Treat associated blepharitis or rosacea
HSV epithelial keratitis (<i>Herpes simplex virus</i>)	Symptoms: History of recurrent HSV infection; pain; extreme photophobia; reduced vision Signs: Reduced visual acuity; commonly unilateral; lacrimation; dendritic ulcer seen on fluorescein stain	<ul style="list-style-type: none"> Refer to ophthalmology for diagnosis and management Topical aciclovir Topical steroid contraindicated
Scleritis (Inflammation of the sclera)	Symptoms: Severe pain exacerbated by eye movement; sleep disturbance as a result of the pain; possible history of systemic inflammatory disease Signs: Reduced visual acuity in severe cases; Usually bilateral; globe tenderness; phenylephrine blanches superficial episcleral vessels but does not affect deeper scleral vessels	<ul style="list-style-type: none"> Emergency ophthalmology referral Oral NSAIDS +/- topical steroids Consider systemic immunosuppression in severe cases
Acute angle closure glaucoma (AACG) (Increased intraocular pressure due to blockage of aqueous drainage)	Symptoms: Severe unilateral pain; reduced vision; haloes; nausea and vomiting; history of previous intermittent attacks Signs: Reduced visual acuity; fixed semi-dilated pupil; corneal oedema; shallow anterior chamber; raised IOP (usually 50-80mmHg) +/- optic disc swelling/atrophy	<ul style="list-style-type: none"> Emergency ophthalmology referral Conservative management: ask patient to lie down to relieve pressure on iridocorneal angle Initiate treatment if diagnosis has been confirmed – IV acetazolamide, pilocarpine drops (if no contra-indications) Ophthalmology treatment is directed to breaking the pupil block and lowering the intraocular pressure – miotics (pilocarpine); systemic agents (acetazolamide); topical anti hypertensives (timolol); topical steroids; YAG laser iridotomy
Acute uveitis (Inflammation of the uveal tract – iris, ciliary body or choroid)	Symptoms: Acute onset; dull pain – can be exacerbated by reading; photophobia; reduced vision Signs: Reduced visual acuity; ciliary flush; keratic precipitates; anterior chamber inflammation; posterior synechiae +/- vitritis / retinitis	<ul style="list-style-type: none"> Emergency ophthalmology referral Topical steroid to reduce inflammation and prevent adhesions Topical cycloplegic drops to relieve ciliary spasm and break posterior synechiae Intraocular pressure (IOP) lowering agents if IOP raised Patient with panuveitis will need systemic investigation +/- systemic immunosuppression Patients with bilateral involvement, recurrent disease (>3 times), granulomatous cases will also require systemic investigation
Exogenous endophthalmitis (<i>Staphylococcus epidermidis</i> , <i>Staphylococcus aureus</i>)	Risk factors: Recent history of surgery; blepharitis; diabetes; complicated surgery Symptoms: Pain, reduced vision Signs: Reduced visual acuity; corneal oedema; anterior chamber activity; hypopyon; posterior segment inflammation – vitritis / retinitis	<ul style="list-style-type: none"> Emergency ophthalmology referral Intravitreal vancomycin + ceftazidime / amikacin +/- vitrectomy +/-. Topical / intravitreal/oral steroids
Corneal foreign body	Symptoms: History of trauma Signs: Lacrimation; corneal foreign body +/- corneal oedema	<ul style="list-style-type: none"> Use local anaesthetic when removing the foreign body If the foreign body is loose, irrigate the eye If foreign body is adherent, use cotton wool bud or sterile 21G green needle to remove the foreign body Topical chloramphenicol for three days after removal of the foreign body Refer to ophthalmology if there is residual foreign body following initial attempts of removal
Chemical injury	Signs: Beware of the 'white' eye – ischaemia; symblepharon; loss of conjunctiva; perlimbal ischaemia; corneal ulceration; corneal oedema; anterior chamber activity; traumatic mydriasis; raised IOP; rarely vitritis, necrotic retinopathy	<ul style="list-style-type: none"> 3ls: Irrigate, Irrigate, Irrigate until pH of 7.5 reached Remove loose particles and sweep the fornices Recheck pH 30 minutes after irrigation to ensure no further leaching of chemicals Emergency ophthalmology referral Topical chloramphenicol if epithelial defect present; topical cycloplegics for pain relief; topical steroids to suppress inflammation; topical potassium ascorbate 10% and oral ascorbic acid to promote healing; topical sodium citrate 10.11% and oral tetracycline has anti-protease properties; topical lubricants

TAKE HOME MESSAGE

- Presentations of red eye are usually benign and can often be managed in the community, however, it is important not to miss a sight-threatening diagnosis!
- Golden questions: Is there any pain? Is there any loss of vision? Presence of these symptoms can be associated with more serious pathology.
- The sight threatening causes of a red eye warranting immediate ophthalmology referral include:
 - Acute angle closure glaucoma
 - Corneal ulcer / abscess
 - Ocular trauma
 - Chemical injuries
 - Endophthalmitis
 - Scleritis
 - Uveitis
- All chemical eye injuries are potentially blinding injuries.
- Abrasions may be missed if fluorescein is not used.
- If in doubt of the aetiology of a red eye, refer to ophthalmology!

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References

1. Kilduff C, Lois C. Red eyes and red-flags: improving ophthalmic assessment and referral in primary care. *BMJ Quality Improvement Reports* 2016;5(1):u211608.w4680.
2. Gilani C, Yang A, Yonkers M, Boysen-Osborn M. Differentiating Urgent and Emergent Causes of Acute Red Eye for the Emergency Physician. *Western Journal of Emergency Medicine* 2017;18(3):509-17.
3. Frings A, Geerling G, Schargus M. Red Eye: A Guide for Non-specialists. *Deutsches Aerzteblatt Online* 2017.
4. Olver J, Cassidy L, Jutley G, Crawley L: *Ophthalmology at a Glance*. Wiley Blackwell; 2005.
5. Sibal N, Tyagi A. Red eye: what's the diagnosis? Guidelines in practice 2018: <https://www.guidelinesinpractice.co.uk/eye-ear-nose-and-throat/red-eye-whats-the-diagnosis/454421.article>
6. Allen R, Harper R: *Basic Ophthalmology*. San Francisco, Calif: American Academy of Ophthalmology; 2016.
7. Scenario: Management of red eye. NICE 2020: <https://cks.nice.org.uk/topics/red-eye/management/>
8. Cronau H, Kankanala R, Mauger T. Diagnosis and management of red eye in primary care. *American Family Physician* 2010;81(2):137-44.
9. Worthing J, Tse A. The Red Eye. Core EM 2019: <https://coreem.net/core/the-red-eye/>
10. Dennison A, Murray P: *Oxford Handbook of Ophthalmology*. 4th ed. Oxford University Press; 2018.
11. Khaw P, Shah P, Elkington A: *ABC of Eyes*. Wiley; 2013.

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