



Ophthalmic Services Guidance

Eye Care in the Intensive Care Unit (ICU)

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Contents

Section	page
1 Summary	3
2 Introduction	3
Protecting the eye of the vulnerable patient	4
3 Identifying disease of the eye	6
Exposure keratopathy and corneal abrasion	6
Chemosis	8
Microbial infections	8
4 Rare eye conditions in ICU	10
Red eye in a septic patient: possible endogenous endophthalmitis	10
Other problems	11
5 Delivering treatment to the eye when it is prescribed	11
Red eye in ICU patient	12
6. Systemic fungal infection and the eye for intensivists	14
7. Tips for ophthalmologists seeing patients in ICU	14
8. Authors	16
9. References	17

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1 Summary

This document aims to provide advice and information for clinical staff who are involved in eye care in the ICU. It is primarily intended to help non-ophthalmic ICU staff to:

1. protect the eye in vulnerable patients, thus preventing ICU-related eye problems
2. identify disease affecting the eye in ICU patients, and specifically those which might need ophthalmic referral
3. deliver treatment to the eye when it is prescribed

It concentrates primarily on the common problems of the eye surface but also touches on other less common conditions. As such, it should also be helpful to those ophthalmologists asked for advice about ICU patients.

2 Introduction

The health of the front surface of the eye, particularly the cornea (the clear front window of the eye) depends on the ability to produce tears, to blink, and to close the eyes with rest or sleep. These can be impaired on the intensive care unit (ICU) whether by disease (e.g. facial oedema, reduced conscious level, peripheral or central neurological injury) or treatments (e.g. the drying effects of gas flows from CPAP or oxygen masks). In particular muscle relaxants reduce the tonic contraction of the orbicularis muscle around the eye which normally keeps the lids closed, and sedation reduces blink rate and impairs (and can eliminate) the blink reflex. Whatever the cause, those unable to close the eye for themselves, or in whom blinking rates are substantially reduced, are at increased risk of damage to the front of the eye, and this risk is higher in those mechanically ventilated, due to greater length of stay, use of sedative/paralysing drugs and the effects of positive pressure ventilation (see below).

The main possible problems affecting the front of the eye in ICU are:

- Direct injury to the cornea - most often a superficial corneal abrasion (scratch) (1)
- Exposure keratopathy
- Chemosis (conjunctival swelling)
- Microbial conjunctivitis and keratitis

ICU eye care protocols are sometimes haphazardly followed, and documentation of eye care is often poor (3). However, having a clear protocol for assessment and intervention, which is applied rigorously and correctly, will prevent the majority of corneal problems (4, 6, 10).

Protecting the eye of the vulnerable patient

Assessment: identifying those at greatest risk of corneal injury

Assessment of eyelid closure must be done at the onset of the care plan and regularly throughout the patient's stay. Incomplete closure of the eyelids is called lagophthalmos. If the eyes do not close properly the grade of severity must be assessed.

Grade 0: Lids completely closed



Grade 1: Any conjunctival exposure (any white of the eye being visible) but no corneal exposure



Grade 2: Any corneal exposure, even a very tiny amount



Protective measures

A variety of methods can be used to protect the eyes of ITU patients. These include:

- Manual closure of the eyes or taping the eyes shut. Lid taping is not always necessary and can be distressing to relatives, and repeated removal may lead to some degree of facial skin or eyelid injury or irritation. It should therefore only be undertaken when necessary.
- Liberal use of lubricants into the eye: ointment (such as simple eye ointment, Lacrilube™ and VitA-POS™) is recommended as drops do not last long enough. This needs to be applied correctly into the eye and not, as is sometimes found, over closed eyelids. Such action is superior to manual eye closure alone and to the (once prevalent) application of Geliperm™ (3).

The action required is based on the grading of exposure:

- Grade 0 exposure (i.e. no exposure) requires no action.
- Grade 1 exposure requires lubrication
- Grade 2 exposure needs lubrication and taping of the lids with Micropore tape along the lash margin.

Eyes should be bathed with warm water first to remove dried ointment. Before the next lubricant application, the eye should be examined with a bright light to look for redness, areas of chemosis or corneal dullness or opacity. If these are found, the medical staff should be alerted (and consideration of referral for ophthalmological opinion given) and considerably increased lubrication given. New ointment is applied to the eye surface: pull the lower eyelid down with a finger and insert the ointment over the top of the lower lid into the gap between the lid and the conjunctiva every 4 hours.



If taping is also performed, ointment is put in first and the eyes are closed (7, 8, 9). The position of the lashes is then checked as the lashes must be clear of the cornea if iatrogenic corneal abrasion is to be avoided). The outside of the eye must be free of the lubricant ointment for tape to stick properly. Micropore™ tape is then applied horizontally across the lids to seal them shut as below:



In those patients *nursed prone and unconscious*, the eyelids and face can become oedematous and conjunctival swelling (chemosis) is common. As in all ventilated patients, exposure keratopathy (a drying of the corneal surface, see below) can occur (10, 11). Direct eye compression can occur and can be avoided using a 3-pin head holder as is used for prone spinal surgery (12). The eyes should always be re-lubricated every 4 hours, and taped shut. Where there is severe oedema and the swollen conjunctiva prolapses through the closed eyelids, the medical staff should be contacted as the eyelids may need to be temporarily closed with sutures.

3 Identifying disease of the eye

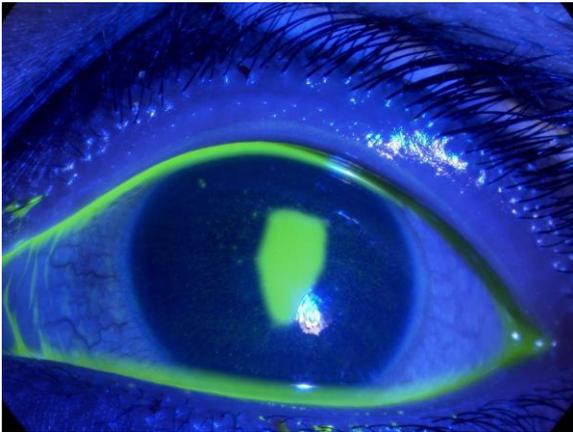
Exposure keratopathy and corneal abrasion

The corneal can be accidentally injured and nearly always in ICU this is in the form of a *corneal abrasion* (a superficial scratch removing the surface epithelium). It will cause the eye to become red and is best seen using fluorescein dye eye drops and a blue light, where the epithelial defect glows bright yellow; a white light will also work but the injury is less obvious. *Exposure keratopathy* represents a dryness of the cornea due to incomplete lid closure allowing excessive tear evaporation and a consequent failure of the tears to spread adequately across the eye surface. It manifests as a red eye and fluorescein dye drops reveal smaller or larger epithelial defects which can look identical to corneal abrasions. It affects 20-42% of ICU patients (3), and 60% of those sedated for >48hours develop corneal epithelial defects (42% within the first week) as a result (1,2). Prolonged epithelial defects can cause scarring or even, in severe cases, perforation of the cornea. Secondary infection (microbial keratitis see below) can occur.

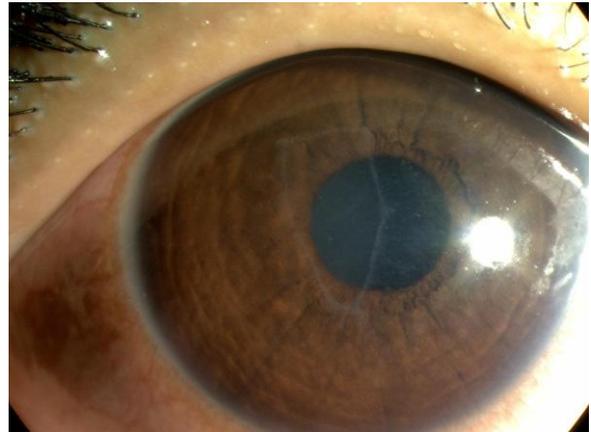
Treatment of a simple corneal abrasion without secondary infection can be with chloramphenicol ointment four times daily for 5 to 7 days and increased lubrication and lid taping if there is significant unwanted corneal exposure.

Corneal abrasion: A) Eye without fluorescein B) stained with fluorescein with blue light showing abrasion on cornea

A

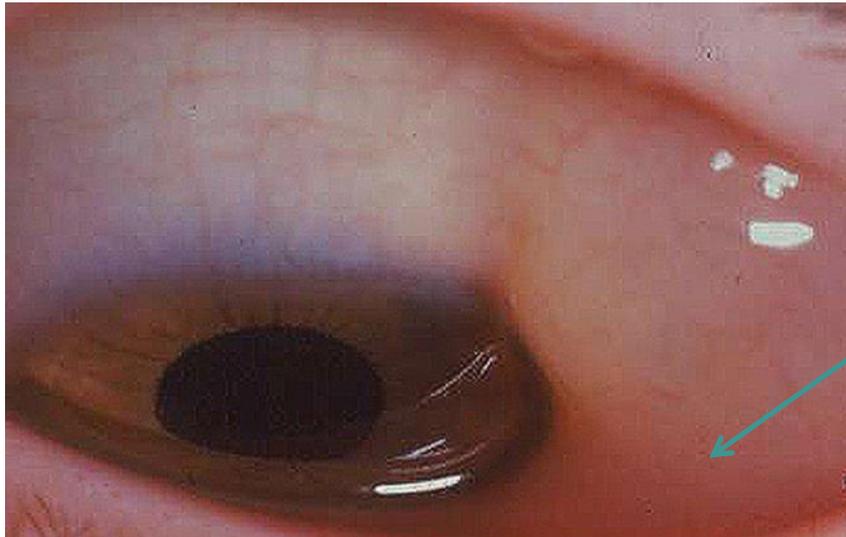


B



Chemosis

Conjunctival oedema which causes the conjunctiva to bulge out (chemosis) is common in ICU patients. Risk factors include those which compromise venous return from the ocular structures (positive pressure ventilation, escalating positive end expiratory pressures or tight endotracheal tube taping); those states associated with generalised oedema (such as fluid overload or hypalbuminaemia); gravitational causes of increased hydrostatic pressure (prolonged recumbency or prone ventilation); or states which increase capillary leak (such as systemic inflammatory response syndromes) (2). Chemosis can cause impaired eyelid closure, whilst incomplete eyelid closure can also predispose to chemosis.



*Swollen conjunctiva
(chemosis)*

Microbial infections

The eye commonly becomes colonized with bacteria (in a time-dependent fashion) on ICU: as many as 77% of ventilated medical patients being colonised by at least one abnormal bacterial species in 7-42 days, 40% of those with prolonged ventilation and sedation with multiple bacteria. The most common isolated organisms are *Pseudomonas aeruginosa*, *Acinetobacter* spp. and *Staphylococcus epidermidis*. (3).

Respiratory secretions are thought to be the major source of ocular surface infection, with aerosols from tracheal suctioning and direct contact from suction catheters both being implicated. *Pseudomonas* infection rates can thus be reduced if endotracheal suctioning is done from the side (rather than head) of the patient & with their eyes covered (4, 5, 6).

Conjunctivitis: ICU staff should look for a sticky eye which is usually (but not always in ICU) red. Note that if the eye is very red but not sticky, this might **not** be conjunctivitis and staff must seek expert ophthalmological help.

RED AND STICKY



RED BUT NOT STICKY



Conjunctivitis in this setting is usually bacterial and can be very infectious and virulent. Without due care it can be spread to other patients and staff.

Management of conjunctivitis: It is wise to take a swab of the eye discharge and send it for microbial culture because of the increased possibility of infection with unusual organisms.

The discharge can be removed by bathing the eyelids with warm water, using separate gauze for each eye.

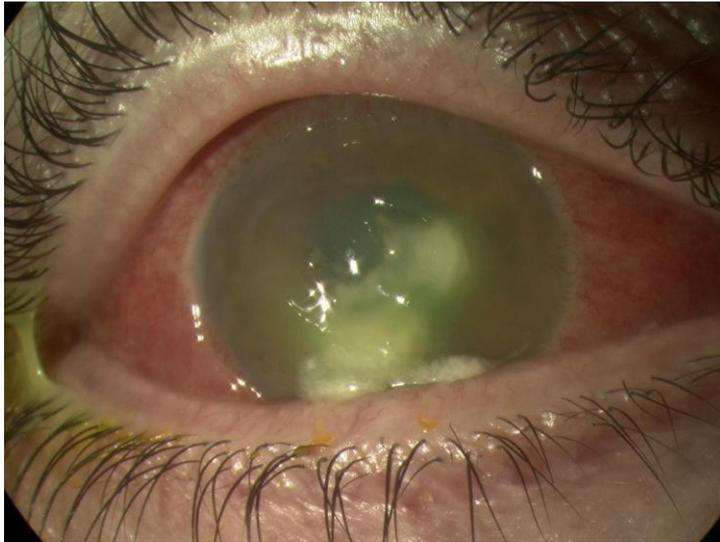
Chloramphenicol ointment (rather than drops to utilise the continued good lubrication from the ointment) is applied in the eye four times a day for 5-7 days.

- If the microbial results suggest that the organism is not sensitive to chloramphenicol, but the eye is better, leave alone and do not change this. If the eye is still sticky or red, then the ointment can be changed to one containing an antibiotic to which the organism is sensitive, or other antibiotic drops can be used in addition to simple lubricant ointment.
- If the discharge and redness have not markedly improved in 48 hours, the medical staff must be informed and ophthalmic help sought.
- If the cornea becomes dull or a white patch appears, ***an urgent ophthalmological opinion sought.***

Microbial keratitis: The damaged cornea (for instance, that affected by exposure keratopathy) is especially vulnerable to bacterial invasion which can occur very rapidly. Whilst superficial infection can result, deeper infection can lead to permanent and severe damage, and loss of vision.

Most cases are due to bacteria and appear as a red eye, which may be watery or sticky, with a corneal ulcer (an epithelial defect -which stains with fluorescein dye- on top of an underlying white/grey/yellowish opacity). Less commonly, debilitated patients may develop herpes simplex keratitis which takes the form of typical “dendrites” in the corneal epithelium and/or ulcers which stain yellow with fluorescein dye, but which can also appear as non-staining grey areas in the cornea. If any of these corneal problems are seen, urgent ophthalmic help must be sought.

RED EYE WITH WHITE PATCH ON CORNEA - LIKELY MICROBIAL KERATITIS



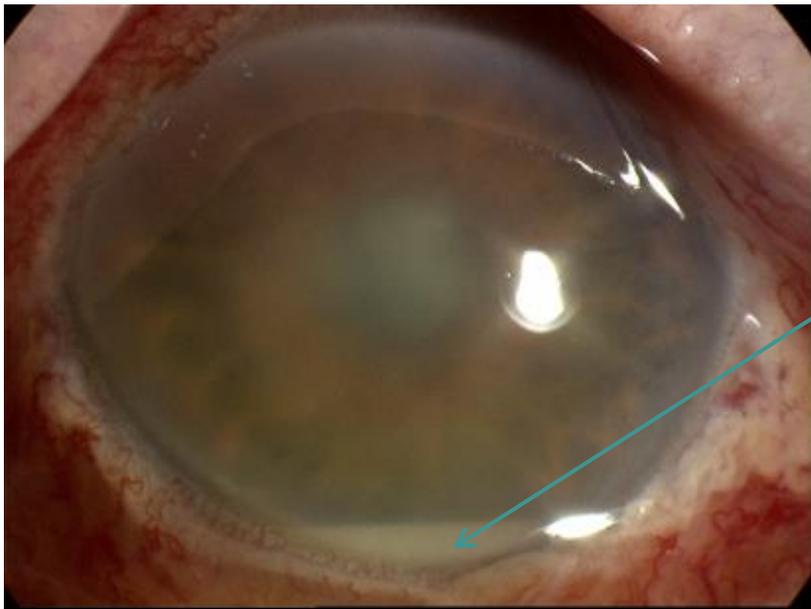
RED EYE STAINED WITH FLUORECEIN DYE SHOWING DENDRITE ON CORNEA – LIKELY HERPES SIMPLEX KERATITIS



4 Rare eye conditions in ICU

Red eye in a septic patient: possible endogenous endophthalmitis

This is a very serious problem caused by spread of systemic infection in the blood stream to the inside of the eye. The eye may be red, although sometimes much less red than might be expected. Endophthalmitis is to be suspected if a white line is visible in the eye in front of the iris, which represents a level of pus in the chamber of the eye (hypopyon). **Immediate** ophthalmic help needs to be sought as this is a sight threatening emergency and it also indicates systemic active sepsis.



Hypopyon – pus in the eye

Other eye problems can complicate ICU care. Severe or recurrent hypotension can cause blindness from ischaemic optic neuropathy (12,13). In those ventilated prone, increased intra-ocular pressures or intraorbital pressure with marked periocular swelling can decrease ocular perfusion pressures (worse with concurrent systemic hypotension), leading to ischaemic optic neuropathy, central retinal artery occlusion and permanent visual loss. (12)

Rarely, those nursed prone can develop bilateral acute glaucoma in which there is a sudden rise in intraocular pressure which can cause visual loss very quickly because of retinal or optic nerve ischaemia. In this condition, the cornea becomes cloudy and grey and the pupil becomes fixed at a mid-dilated position and unresponsive to light. This needs **immediate** ophthalmic treatment.

5 Delivering treatment to the eye when it is prescribed

This is usually given in the form of drops or ointment. Sometimes several different drops are required.

- When giving several different drops, do not give them at the same time as one drop may wash out another, thereby reducing its effectiveness. Allow ideally 5 minutes and at least 1 minute between each medication
- Always put drops in before ointment. The ointment is water repellent and prevents the drops from getting into the eye tissues.
- When putting in ointment in poor lid closure, after instilling ointment manually shut eyelids to ensure ointment is spread over whole eye surface.

Table 1 Patient nursed supine and unconscious

Grade	Action
Grade 0 – eyelids close well	No action required
Grade 1 – some conjunctival exposure	<p>EYES NEED LUBRICATING EVERY 4 HOURS</p> <ul style="list-style-type: none"> • Clean off old ointment before putting in new • Pull lower lid down and instil ointment onto eye between lower lid and conjunctiva • Always check corneal clarity with bright light: IF NOT CLEAR – ALERT MEDICAL STAFF
Grade 2 – conjunctival and some corneal exposure – MAJOR RISK	<p>EYES NEED LUBRICATING AND LIDS TAPING</p> <ul style="list-style-type: none"> • Apply ointment as for Grade 2 • Close lids, ensure lashes outside eye and lids free of ointment • Tape upper lid down with micropore tape horizontally • Always check corneal clarity with bright light: IF NOT CLEAR – ALERT MEDICAL STAFF

Table 2 Patient nursed prone and unconscious

Major risk to eye in all cases
<p>EYES NEED LUBRICATING AND LIDS TAPING</p> <ul style="list-style-type: none"> • Apply ointment as for Grade 2 • Close lids, ensures lashes outside eye and lids free of ointment • micropore tape horizontally • Always check corneal clarity with bright light: IF NOT CLEAR – ALERT MEDICAL STAFF

Red eye in ICU patient

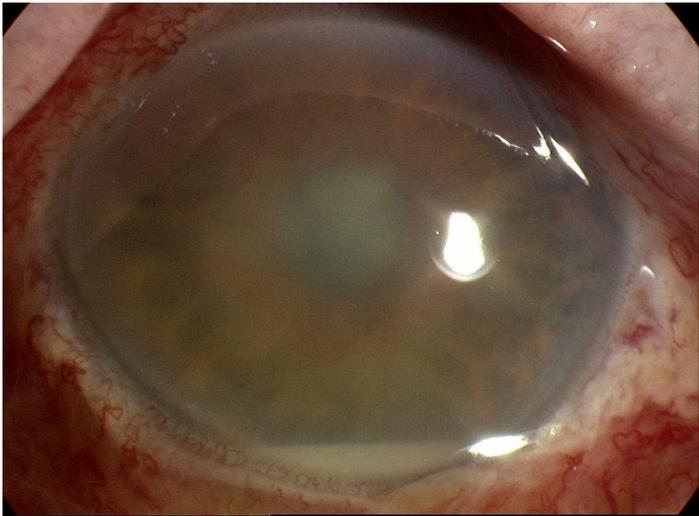
Table 3 Eye sticky

<ul style="list-style-type: none"> • Take swab • Use chloramphenicol ointment X 4/DAY to eye • Condition is contagious and can be transmitted to other patients • IF NO BETTER IN 24 HOURS – ALERT MEDICAL STAFF

Table 4 Eye not sticky

- Is the cornea clear or does it stain with fluorescein drops?
- If clear cornea, or simple abrasion, check lubrication schedule and consider lid taping
- If corneal opacity or eye not dry – **ALERT MEDICAL STAFF**

White line visible inside eye: ALERT MEDICAL STAFF IMMEDIATELY



6. Systemic fungal infection and the eye for intensivists

It is important to recognise that the eye may be involved in any patient who has a systemic fungal infection and this is particularly important in ITU where the patient is unlikely to be able to report any problems with their eyesight. Of the systemic antifungal agents neither echinocandins nor amphotericin preparations penetrate the eye sufficiently to treat intraocular disease and visual loss may happen despite effective control of the systemic infection. We recommend:

- All patients with a positive blood culture or line tip for candida, aspergillus or any other fungal organism should be referred for urgent ophthalmological assessment.
- If intraocular fungal disease is detected, treatment with an anti-fungal that penetrates the eye is needed. For *Candida albicans* this will generally be fluconazole (unless evidence of resistance) but for non-*albicans* candida or aspergillus voriconazole is the preferred agent. Local ID or microbiology services will be able to advise on the most suitable agent.
- If any patient complains of a change in vision when they wake up on ITU then intraocular infection should be considered in the differential diagnosis and urgent ophthalmological review organised.

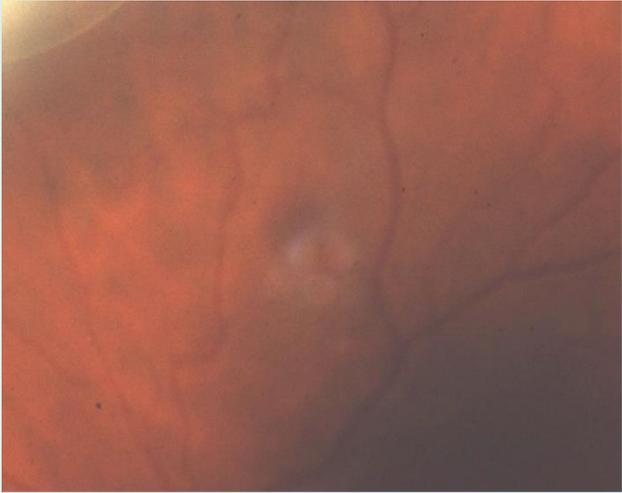
7. Tips for ophthalmologists seeing patients in ICU

1. If **corneal exposure and taping requested**, ensure taping done correctly to avoid lashes rubbing on the cornea.
2. If **keratitis** present, it is most likely to be bacterial and virulent bacteria – especially pseudomonas. Therefore, do a corneal scrape and start appropriate intensive topical antibiotic therapy immediately. Try to avoid lid taping (which can encourage bacterial growth) and keep lubricated with plenty of ointment.
3. **Endogenous bacterial endophthalmitis** – most likely if a hypopyon is present. Be guided by systemic infection if known, otherwise urgently tap and inject using protocol of amikacin and vancomycin. If platelet count is low (<30,000), there is a risk of vitreous haemorrhage, so ask for platelets to be given before you do the procedure.
4. The most common systemic fungal infection is from **candida spp.**
If positive blood culture/long line catheter, then urgently examine dilated eyes using an indirect ophthalmoscope. It is safe to use G tropicamide 1% and G. phenylephrine 2.5%, but write clearly in the notes that the pupils have been dilated, stating the time

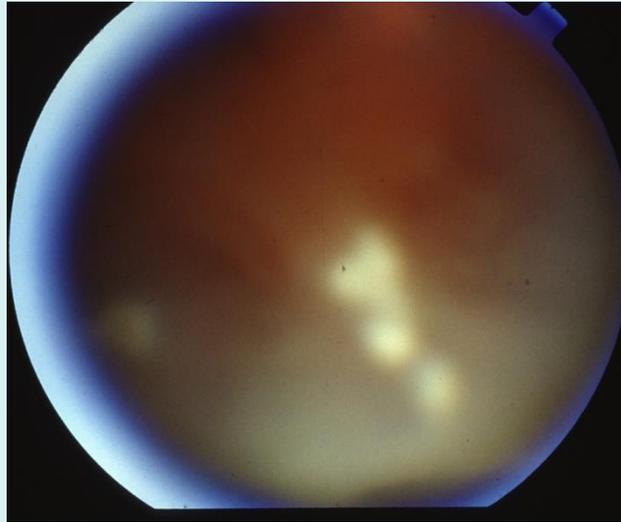
drops were given and the time over which pupils are likely to be unresponsive to light (about 4 hours).

Physicians will generally use echinocandins such as caspofungin or liposomal amphotericin amphotericin to treat systemic fungal infections in the ICU but these agents do NOT adequately penetrate the eye. Azole antifungals such as fluconazole or voriconazole do penetrate well.

Table 5 *Candida*

Location of candida	What does it look like?	Treatment
Candida in choroid	 <p data-bbox="469 1093 762 1128">Lesions grey and deep</p>	<p data-bbox="1150 566 1385 752">Lesions are outside the BRB, so systemic amphotericin will be effective.</p>
Candida in retina	 <p data-bbox="469 1787 753 1823">Lesions white but flat</p>	<p data-bbox="1150 1155 1385 1581">Inside the Blood-retinal-barrier, so systemic amphotericin (even in lipophilic form) will not achieve a local Minimum Inhibitory Concentration (MIC).</p> <p data-bbox="1150 1585 1385 1926">Fluconazole (oral or intravenous) is thus needed. Then watch daily to ensure that infection does not progress to involve the vitreous.</p>

Candida in vitreous



Classic string of pearls appearance

Lesions now in the vitreous. Give 10ug intravitreal amphotericin plus oral fluconazole. If the patient survives, they are likely to need vitrectomy to prevent tractional retinal detachment.

5. **If candida spp not sensitive to fluconazole**, voriconazole can be used: it penetrates the eye well. Caspofungin does **not**.
6. **If patient has cystic fibrosis, always think of aspergillus first as the cause of endophthalmitis** as patients are usually colonised with this. Use voriconazole as first line therapy.
7. **Patients on voriconazole may get visual aura** because it is a cytochrome P450 inhibitor and this is present in the RPE. These aura are totally reversible when the drug is stopped and are NOT an indication to stop the drug.
8. **Patients nursed prone** may suffer direct pressure on eyes or raised orbital/ophthalmic pressure due to gravitational effects or periorbital swelling. This can cause acute primary angle closure glaucoma, ischaemic optic neuropathy, vascular occlusion and, rarely, orbital apex syndrome (visual loss from optic neuropathy with ophthalmoplegia involving multiple cranial nerves). Pressure needs to be taken off the eyes where possible (14)
9. **Patients who are profoundly hypotensive** for extended periods of time may get ischaemic optic neuropathy or cortical blindness causing visual loss

8. Authors

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Approved by:

- The Royal College of Ophthalmologists' Professional Standards Committee
 - The Intensive Care Society and the Faculty of Intensive Care
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