Orbital cellulitis: assessment and management

Introduction

Orbital cellulitis is an infection of the orbital soft tissue contents. It is a potentially sight-threatening condition, associated with intracranial complications. Accurate assessment and prompt specialist referral for appropriate medical and possible surgical management is essential in avoiding complications.

Orbital anatomy

Seven facial bones conjoin to form the orbit, a pear-shaped mid-facial cavity that serves to protect and maximize the function of the eye and its adnexa.

The apex of the conical orbit lies posteriorly at the medial aspect of the superior orbital fissure. The optic nerve enters the orbital apex through the optic canal, which in turn communicates directly with the middle cranial fossa. The base of the orbit lies in the plane of the orbital rim anteriorly and is formed by the frontal bone superiorly, the frontal and zygomatic bone laterally, the zygomatic and maxillary bone inferiorly and the maxillary, lacrimal and frontal bones medially.

The orbital septum is a fascial extension of the orbital rim periosteum, which inserts vertically into the superior border of the upper eyelid tarsal plate and the inferior border of the lower eyelid tarsal plate to form the anterior limit of the orbit. Soft tissue infection of the eyelids and periocular adnexa anterior to the orbital septum defines preseptal cellulitis, while orbital cellulitis is soft tissue infection of the orbital contents posterior to the orbital septum.

It is important to distinguish preseptal cellulitis from orbital cellulitis as they are separate disease entities with different aetiology, pathogenesis and management.

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Paranasal sinuses

The paranasal sinuses are anatomically closely related to the orbit, with the frontal sinus bordering the orbit superiorly and the maxillary sinus inferiorly. Medially, the ethmoidal air cells are separated from the orbital contents by the lamina papyracea, a paper-thin plate of bone. In addition, the medial wall of the orbit consists of the frontal process of the maxilla, the lacrimal bone and the sphenoid and is perforated by numerous neurovascular channels. This anatomical arrangement of thin bone and multiple foramina predisposes the orbit to contiguous spread of infection from the ethmoid sinus.

Aetiology

Paranasal sinusitis is the most common predisposing factor in the development of orbital cellulitis. A case series by Nageswaran et al (2006) reported the incidence of orbital cellulitis secondary to sinusitis in a paediatric population to be 100%, with ethmoid sinusitis accounting for 98%. Orbital cellulitis has a seasonal variation, with an increased frequency in winter attributed to the increased incidence of sinusitis. Other sites of periorbital infection predisposing to orbital cellulitis include contiguous spread from preseptal cellulitis, endophthalmitis, dacrocystitis, orbital bone osteomyelitis and dental infections via an intermediary maxillary sinusitis.

Further aetiological factors predisposing to the development of orbital cellulitis involve direct inoculation of pathogens into the orbit during penetrating trauma, orbital fractures or iatrogenically following surgery. Alternatively, organisms may be introduced into the orbit haematologically following systemic bacteraemia.

Pathogens

There has been a recent evolution in the pathogens most commonly implicated in orbital cellulitis. With the advent of *Haemophilus influenzae* type B vaccination, Ambati et al (2000) reported a sharp decline in the number of cases and annual rate of orbital cellulitis attributed to *H. influenzae*. Streptococcal and staphylococcal species now appear to be the predominant cause.

Harris (1994) reported patient age as a factor in the bacteriology and response to treatment. In his series 80% of children under the age of 9 years had negative cultures or responded to intravenous antibiotic therapy without surgical drainage. The positive cultures grew only single aerobes (*Streptococcus pneumoniae* or *Staphylococcus aureus*). In contrast, infection in children over the age of 9 years did not usually respond to intravenous antibiotic therapy alone and required drainage. The culture results for these children were polymicrobial, usually consisting of a mixture of aerobes (*Strep. anginosus* (*milleri*), group A and group C streptococci, *Staph. aureus*, *H. influenzae* and *Moraxella catarrhalis*) and anaerobes (*Peptostreptococcus*, *Eikenella*, *Fusobacterium* and *Bacteroides* species). Brook and Frazier (1996) reported similar aerobic and anaerobic polymicrobial infections in adult subperiosteal orbital infections and noted the cultures to correlate with maxillary sinus puncture c ultures obtained from the same patients.

McKinley et al (2007) highlighted the increasing occurrence of meticillin-resistant *Staph. aureus* (MRSA), indicating that empiric antimicrobial therapy should be directed against these organisms should they be prevalent in the community.

Mucormycosis remains a rare but important opportunistic cause of orbital cellulitis in diabetics and the immunocompromised. Rhino-orbital-cerebral mucormycosis is an aggressive, rapidly spreading and potentially fatal fungal infection.

History

Patients generally present with a history of acute onset unilateral lid swelling with an associated red and painful eye. They may report blurred vision, double vision, headaches, fever and systemic malaise. If not volunteered, it is important to enquire about a preceding ear, nose, upper respiratory tract or systemic infection and any recent facial trauma, surgery or dental work. A complete history should include diabetic and immune status.

Examination

Examination is likely to reveal warm and tender eyelids with associated oedema,

erythema and dark discolouration (*Figure 1*). Altered periorbital and corneal sensation may be apparent.

Globe proptosis and ophthalmoplegia are the cardinal features of orbital cellulitis and are associated with conjunctival chemosis and injection, diplopia, pain on eye movement, resistance to globe retropulsion and elevated intraocular pressure.

Orbital cellulitis is potentially sight threatening. As ocular complications, which include optic nerve compression and anterior ischaemic optic neuropathy, may be permanent and progress rapidly, careful daily evaluation of optic nerve function is an essential part of management. Functional parameters include best-corrected visual acuity, pupillary reactions (relative afferent pupillary defect), colour vision, visual fields and direct visualization of the optic nerve head on ophthalmoscopy.

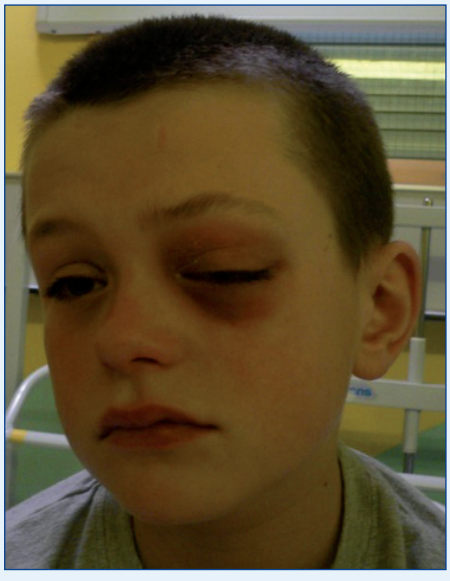
Complete assessment entails full neurological examination to exclude meningeal or cerebral involvement.

Investigations

Orbital cellulitis is a clinical diagnosis. Investigations serve to confirm the diagnosis, identify a possible aetiological agent to guide antimicrobial therapy and ascertain whether surgical therapy may be of benefit.

Biochemical investigations include a full blood count with differential.

Figure 1. Left orbital cellulitis with associated swelling, erythema and dark discolouration of the upper and lower eye lids.



Microbial cultures should include blood samples collected before the administration of antimicrobial therapy and swabs taken of any purulent discharge present in the nose, conjunctiva, skin breaks and throat, or obtained directly from an orbital abscess or sinus washout. Lumbar puncture is indicated in the advent of neurological signs.

Axial (*Figure 2*) and coronal (*Figure 3*) high-resolution computed tomography with contrast remain the gold standard imaging modality in orbital cellulitis. The images may help define subperiosteal, orbital, peridural and parenchymal brain abscesses, in addition to identifying paranasal sinusitis, retained orbital or intraocular foreign bodies and cavernous sinus thrombosis.

Classification

The most widely quoted scheme of classification of orbital cellulitis is the Chandler classification. This classification system does not necessarily imply an order of disease progression, but explains the signs and symptoms of the underlying infection, gives an indication of severity and likelihood of progression to possible complications, aids in effective interdisciplinary team communication and helps organize and plan treatment. Chandler et al (1970) described five categories as outlined in *Table 1*.

Management

Orbital cellulitis demands prompt and aggressive treatment. Early consultation

Figure 2. Axial computed tomography scan demonstrating left ethmoidal sinusitis with contiguous spread and sub-periosteal abscess formation.

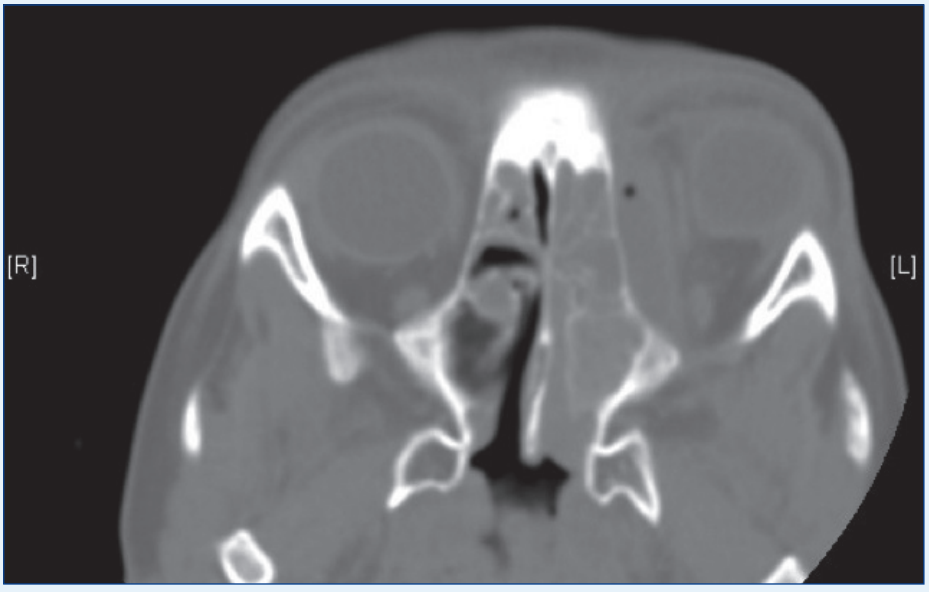
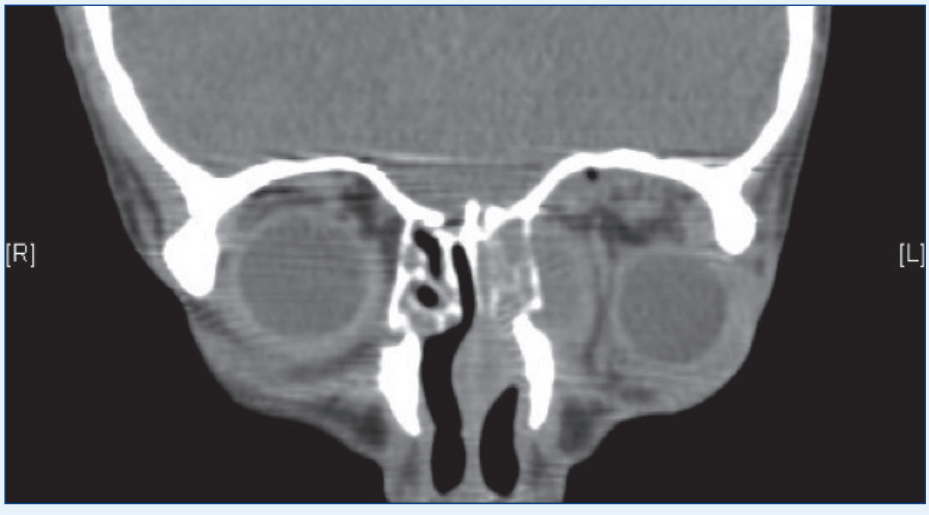


Figure 3. Coronal computed tomography scan of the same patient. Note left eye medial rectus and globe displacement.



with ophthalmic and ear, nose and throat specialists is required to plan management.

Patients require hospital admission for high-dose intravenous antibiotics. Protocols vary locally, but initial empiric treatment should include broad-spectrum antibiotics to cover gram-positive, gram-negative and anaerobic organisms for at least 72 hours. It is reasonable to consider oral antibiotics once patients have been apyrexial for 48 hours.

Treatment protocols differ, reflecting regional differences in initiating pathogens and local drug resistance. Kunimoto et al (2004) suggest the antibiotic treatment regimen outlined in *Table 2*.

Adjunct nasal decongestants are required to decongest sinus ostia and encourage drainage. Topical corneal antibiotics and lubricants are appropriate in cases of severe proptosis with secondary exposure keratopathy.

A low threshold should be maintained for computed tomography imaging, as a persisting orbital abscess can be difficult to clinically differentiate from cellulitis without abscess formation, and the consequences of suboptimal management can be dire. If there is a decrease in visual acuity or failure to rapidly respond to intravenous antibiotics, computed tomography imaging is mandatory. Surgical drainage is indicated if orbital or sub-periosteal abscess collections are demonstrated on computed tomography. Surgery may also be indicated if there is an atypical clinical picture requiring diagnostic biopsy. Simultaneous sinus surgery may be warranted, e.g. drainage of the ethmoid sinuses.

Table 1. Classification of orbital cellulitis

Group I	Inflammatory oedema affecting the eyelid with or without oedema of the orbital contents and no limitation of extraocular movements
Group II	Orbital cellulitis, defined as a diffuse oedema of the orbital contents with no abscess formation
Group III	Subperiosteal abscess, a collection of pus between the periorbita and the bony wall of the orbit
Group IV	Orbital abscess, a discrete collection of pus within the orbital tissue
Group V	Cavernous sinus thrombosis indicates posterior extension of the phlebitis into the cavernous sinus

From Chandler et al (1970)

Complications

Complication may be ocular or neurological.

Ocular complications may result in permanent visual loss. Recognized causes of visual loss include corneal damage secondary to exposure keratopathy or neurotrophic keratitis, endophthalmitis, optic neuritis, secondary glaucoma, central retinal vein occlusion and anterior segment ischaemic syndrome secondary to raised intraorbital pressure. Permanent ophthalmoplegia may occur following ocular motor nerve or extraocular muscle involvement or orbital fibrosis.

Neurological complications are serious and rapidly progressive and occur following intracranial extension of the orbital infection. These complications, which may be avoided with early aggressive therapy, include cavernous sinus thrombosis, meningitis, raised intracranial pressure and epidural, subdural and cerebral brain abscess formation.

Conclusions

Orbital cellulitis is a sight-threatening and potentially fatal infection of orbital contents posterior to the orbital septum. Prompt clinical diagnosis, aggressive management with high dose intravenous antibiotics and early multi-specialist referral is essential in avoiding long-term ocular and neurological complications. Surgical intervention is indicated in cases with decreased visual acuity, no response to antibiotic therapy in the presence of orbital or sub-periosteal abscess collections demonstrated on computed tomography, or clinically atypical cases warranting diagnostic biopsy. **BJHM**

Conflict of interest: none.

Ambati BK, Ambati J, Azar N, Schmidt EV (2000) Periorbital and orbital cellulitis before and after the *Haemophilus influenza* type B vaccination. *Ophthalmology* **107**(8): 1450–3

Brook I, Frazier EH (1996) Microbiology of subperiosteal orbital abscess and associated sinusitis. *Laryngoscope* **106**(8): 1010–13

Chandler JR, Langenbrunner DJ, Stevens ER (1970) The pathogenesis of orbital complications in acute sinusitis. *Laryngoscope* **80**(9): 1414–28

Harris GJ (1994) Subperiosteal abscess of the orbit. Age as a factor in the bacteriology and response to treatment. *Ophthalmology* **101**(3): 585–95

Kunimoto DY, Kanitkar KD, Makar MS (2004) *The Wills Eye Manual.* 4th edn. Lippincott, Williams and Wilkins, Philadelphia

McKinley SH, Yen MT, Miller AM, Yen KG (2007) Microbiology of paediatric orbital cellulitis. *Am J Ophthalmol* **144**(4): 497–501

Nageswaran S, Woods CR, Benjamin DK Jr, Givner LB, Shetty AK (2006) Orbital cellulitis in children. *Pediatr Infect Dis J* **25**(8): 695–9

Table 2. Antibiotic treatment protocol for orbital cellulitis

Children (aged 1 month–13 years)	Ceftriaxone 100 mg/kg/day intravenous in two divided doses (maximum 4 g/day) plus vancomycin 40 mg/kg/day intravenous in two to three divided doses
Adults	Ceftriaxone 1–2 g intravenous 12-hourly plus vancomycin 1 g intravenous 12-hourly
	If anaerobic infection is suspected consider adding metronidazole 15 mg/kg intravenous loading dose over 1 hour then metronidazole 7.5 mg/kg intravenous 6-hourly (maximum 4 g/day)
Penicillin- or cephalosporin-allergic adults	Vancomycin 1 g intravenous 12 hourly plus gentamycin 5 mg/kg intravenous daily
	Or clindamycin 300 mg intravenous 6-hourly plus gentamycin 5 mg/kg intravenous daily

From Kunimoto et al (2004)

KEY POINTS

- Orbital cellulitis is a soft tissue infection of the orbital contents posterior to the orbital septum.
- Orbital cellulitis is a sight-threatening and potentially fatal condition requiring aggressive management and early specialist referral.
- High-resolution computed tomography with contrast remains the gold standard imaging modality in orbital cellulitis. There should be a low threshold for proceeding to imaging.
- All cases of orbital cellulitis require hospital admission for high dose intravenous antibiotics.
- Surgical intervention is indicated if there is a decrease in vision or no response to antibiotic therapy in the presence of a demonstrated orbital or sub-periosteal abscess.