Assessment and management of orbital cellulitis

Orbital cellulitis is a medical emergency requiring multidisciplinary team involvement. Early diagnosis and intervention is imperative to avoid serious complications. This article provides an evidence-based approach to the assessment and management of patients with orbital cellulitis.

Orbital cellulitis is a medical emergency that requires multidisciplinary management involving input from the emergency physician, paediatrician, ear, nose and throat surgeon and ophthalmologist. The key aim is early diagnosis and aggressive management of infection to avoid ocular and neurological complications. This article reviews the most up-to-date evidence on the diagnosis, investigation and treatment of orbital cellulitis.

Pathogenesis

Sinonasal disease is the most common originating source for infection (Nageswaran et al, 2006). Acute sinusitis is common in children, accounting for around one fifth of paediatric antibiotic prescriptions (Oxford and McClay, 2006). More rarely infection may spread from dacryocystitis or skin infections. Direct inoculation of infection into the orbit from trauma, fractures or surgery is also recognized.

Sinonasal infection spreads from the sinuses directly through the lamina papyracea, which may be dehiscent, or through venous drainage. Infection from the orbit may drain into the cavernous sinus and therefore cause cavernous sinus thrombosis and neurological complications.

Haemophilus influenzae type B (Hib) is a strongly virulent pathogen and was one of the most common isolated organisms in paediatric patients with orbital cellulitis (Gellady et al, 1978; Smith et al, 1978). Bacteraemia and meningitis in patients with HiB orbital cellulitis was not infrequent (Ambati et al, 2000).

The introduction of the universal HiB vaccination in 1985 with associated herd immunity has shown a dramatic reduction and continued decline in the incidence of HiB-associated orbital cellulitis (Ambati et al, 2000; McKinley et al, 2007; Sharma et al, 2015). *Haemophilus* spp. is still a rare dangerous cause of orbital cellulitis and should be considered in older patients and in those who did not follow the national vaccination programme.

Streptococcus spp. is becoming more prevalent with the specific organism depending on the age (Oxford and McClay, 2005). Younger children are more likely to have *S. pneumoniae* and older children group A Streptococcus. However, this may change with the widespread introduction of pneumococcal conjugate vaccination. *Strep. anginosus* is part of the normal upper respiratory and gastrointestinal flora but can be pathological (Seltz et al, 2011).

Streptococcal organisms tend to be less invasive than *H. influenzae* organisms. This explains the reduction in neurological complications secondary to spread of orbital cellulitis such as meningitis.

Staphylococcus spp. have become more prevalent and methicillin-resistant *Staph. aureus* is a growing concern with geographical variance. The advice of the local microbiologist should be sought (Botting et al, 2008; Pena et al, 2013). Anaerobes have been identified in a significant minority of patients and this should be taken into consideration with respect to antibiotic cover (Oxford and McClay, 2006).

In adults, wider spectrums of pathogens are often found with polymicrobial aetiology (Murphy et al, 2014). Non-infectious causes including inflammatory conditions and malignancy should also be considered in the differential diagnosis (Nair et al, 2014).

In immunocompromised patients atypical and fungal organisms should be contemplated. Infections can be locally aggressive in these patients and may rarely cause necrotizing orbital and facial infections (Contreras-Ruiz et al, 2015).

History

Patients often describe an initial acute unilateral swelling of the eyelid that may be painful. Pain does not always occur, especially in children, often leading to delayed presentation (Fokkens et al, 2012). Diplopia may be described and loss of vision is a concerning late sign of orbital infection.

As the most common cause is acute rhinosinusitis the patient may complain of nasal blockage, facial pressure and pain, nasal discharge and post nasal drip.

Relevant points in the history include previous acute or chronic rhinosinusitis, upper respiratory tract infection, trauma, recent orbital or sinus surgery, dacrocystitis or local skin infection.

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Comorbidities such as immunosuppression or diabetes mellitus are particularly relevant as they may be associated with an aggressive disease course or unusual pathology, e.g. fungal infection (Sridhara et al, 2005; Badiee et al, 2012).

Socioeconomic studies have shown an association between intracranial complications and patients with poor access to health care and those from a lower socioeconomic background (Sedaghat et al, 2014).

Examination

The eye and surrounding soft tissues should be inspected for periocular oedema, erythema, conjunctival chemosis and injection (*Figure 1*). Soft tissue swelling often causes ptosis. The palpebral aperture should be sequentially measured to assess improvement. The periocular region should be palpated for any masses or particularly tender spots that may represent a causative factor such as dacryocystitis or a chalazion. Proptosis, restricted extraocular movement or globe displacement may be present in more severe cases.

A formal ophthalmic examination should be sought including visual acuity, relative afferent pupillary defect and fundoscopic examination. Pinhole visual acuity is important as the visual acuity can often be reduced secondary to swelling or discharge rather than optic nerve involvement. Assessment of colour vision using Ishihara test plates is useful as loss of red–green colour discrimination is one of the first defects of vision to become apparent. Electronic Ishihara plates on portable devices have been validated and shown to be effective for this purpose (Awad et al, 2007).

Measurement of intraocular pressures is pertinent for patients with proptosis or resistance to globe retropulsion.

Examination of the nasal airway, preferably using a rigid or flexible nasendoscope, for signs of acute rhinosinusitis, e.g. inflammation, mucopus and oedema around the middle meatus, will confirm the source of the infection.

The patient should be examined for any systemic signs of sepsis, e.g. pyrexia or tachycardia. A neurological assessment including cranial nerve examination is important to exclude cavernous sinus thrombosis and cerebral complications.

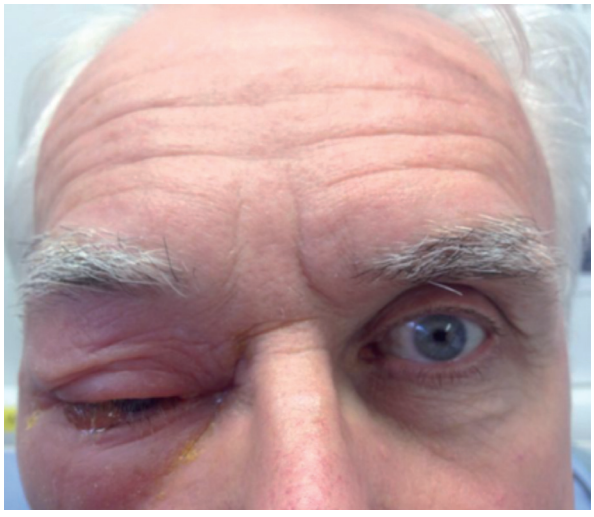
Severity assessment

The cornerstone of management involves assessing the disease severity and establishing whether the patient may be managed with aggressive medical therapy or surgical intervention. This is determined by clinical assessment and further investigations.

It is important to establish whether the patient has a 'preseptal' or 'postseptal' cellulitis. The orbital septum is a fibrous multilayered membrane arising from the arcus marginalis at the inferior and superior orbital rims. It merges superiorly with the levator aponeurosis inserting just superior to the tarsal plate of the upper eyelid. In the lower lid it fuses with the capsulopalpebral fascia. This fascial sheet then inserts into the lower edge of the inferior tarsal plate.

Preseptal cellulitis involves tissue anterior to the orbital septum. This may manifest as eyelid oedema, erythema and pain, but there should be no proptosis or ophthalmoplegia.

Figure 1. Patient with right-sided preseptal cellulitis showing periocular oedema, erythema and mechanical ptosis.



It is commonly secondary to local trauma or an infective source in the skin such as a chalazion. Diagnosis of preseptal cellulitis is predominantly clinical and further imaging is often not required.

Inflammation in the postseptal structures shows signs such as pain, chemosis, ophthalmoplegia, proptosis and visual loss. It is extremely difficult to exclude the presence of a subperiosteal or orbital abscess in a patient with postseptal involvement by clinical examination alone and radiological examination is required.

Radiological signs in orbital cellulitis include diffuse soft tissue changes anterior to the orbital septum representing lid changes. There may be inflammatory stranding in the orbital fat. Subperiosteal abscess may be present and the majority of these are medial associated with ethmoid sinusitis (Oxford and McClay, 2006). Intraorbital abscess is a rare finding. Air within the mass is most likely secondary to anaerobic bacteria (Fokkens et al, 2012). Adjacent abscess or inflammation may cause muscle enlargement or displacement and the globe may also be displaced. Neurological involvement such as cavernous sinus thrombosis, superior ophthalmic vein thrombosis or an intracranial abscess should be assessed.

Sinus involvement on imaging can indicate that the causative aetiology for the orbital cellulitis is sinonasal disease and therefore treatment against *Streptococcus* and *Staphylococcus* spp. given as first-line therapy.

The presence of soft tissue hyperattenuation with calcification and local irregular osseous erosion or destruction may point towards alternate diagnoses such as fungal sinonasal disease or malignancy as the pathogenesis of the orbital cellulitis (Ilica et al, 2012; Mossa-Basha et al, 2013).

Classification

The terminology related to periorbital cellulitis has often been debated. The most common classification is attributed to Chandler et al (1970) who classified patients into five different disease groups:

- Group I – preseptal cellulitis
- Group II – orbital cellulitis
- Group III – subperiosteal abscess
- Group IV – orbital abscess
- Group V – cavernous sinus thrombosis.

The advantage of this classification is that it is well known to the various medical specialties involved in the care of the patient, so is useful for communication between physicians.

Terminology used to describe orbital complications is often contentious. It is important to note that the term preseptal cellulitis describes an inflammatory process involving the eyelid not the orbit and can have many other causes.

Adding further confusion to this classification, cavernous sinus thrombosis is actually an intracranial complication. It is most commonly associated with sphenoid sinus disease and can occur in the absence of orbital cellulitis. It is important during documentation and classification to state the presence or absence of orbital symptoms (Fokkens et al, 2012).

Investigations

Baseline tests

Patients with orbital cellulitis should be routinely analysed for full blood count with differential and inflammatory markers, e.g. C-reactive protein and/or erythrocyte sedimentation rate. Robinson et al (2007) showed that only half of adult patients had normal white cell counts on presentation.

Venous blood culture and sensitivity is contentious as a baseline investigation. Studies have shown a very low positive culture from venous blood cultures. Pre-antibiotic venous blood cultures yield an isolated organism in 0–7% of cases in comparison with microscopy, culture and sensitivity undertaken on surgical culture samples, which have up to 90% positive culture rate (Oxford and McClay, 2006; McKinley et al, 2007; Seltz et al, 2011; Sharma et al, 2015).

Mucopus from the nasal airway should be sent for microscopy, culture and sensitivity.

Imaging

High-resolution contrast-enhanced computed tomography of the paranasal sinuses and orbits are the gold standard radiological investigation to identify an abscess (Fokkens et al, 2012).

Computed tomography scanning should be undertaken in patients with:

1. Neurological symptoms secondary to the infection
2. Inability to accurately assess the patient's vision
3. Advanced ophthalmological signs such as:
   - Gross proptosis
   - Ophthalmoplegia
   - Worsening visual acuity or colour vision
   - Bilateral oedema.
4. Failure to respond to medical treatment after 24 hours
5. Fluctuating pyrexia not responding to medical treatment within 36 hours (Howe and Jones, 2004).

The computed tomography scan will help confirm the diagnosis and assess the severity of infection including identification of spread of disease.

Figure 2. Axial computed tomography scan showing a right-sided medial subperiosteal collection which is intimately related to and eroding the right lamina papyracea. Associated anterior soft tissue changes and opacity of the right ethmoid sinus are seen. Note the displacement of the medial rectus laterally. The left orbit has a normal appearance with no evidence of bilateral disease.

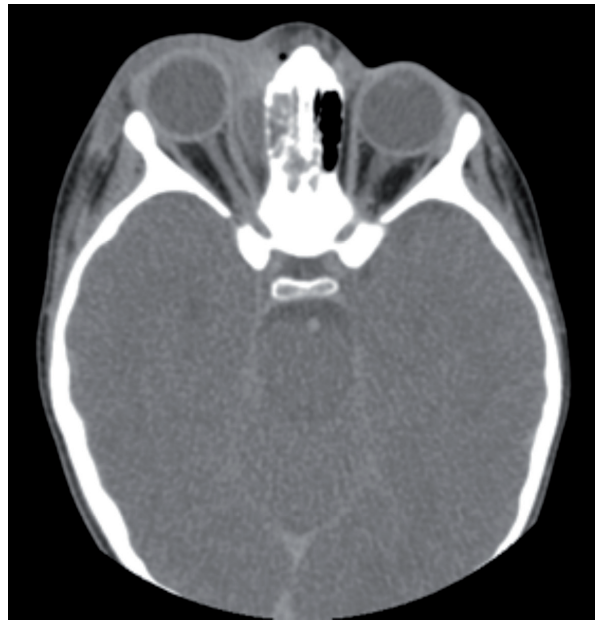
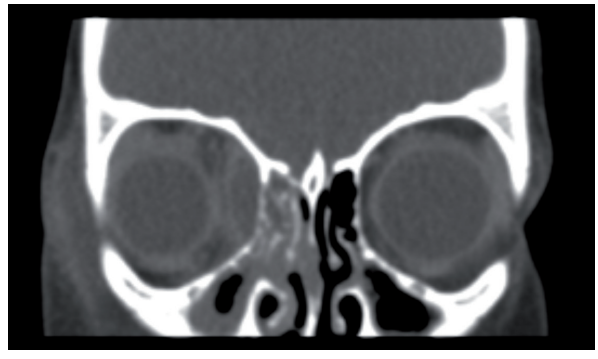


Figure 3. Coronal computed tomography scan showing ethmoid opacification and subperiosteal abscess formation.



In patients not responding to medical treatment the additional role of computed tomography scanning is to identify and localize any surgically drainable abscess that would not respond to medical treatment alone. This information is useful to guide surgical planning and approach.

Assessment of the sinuses, orbits and intracranial structures can be undertaken with computed tomography (*Figures 2* and *3*).

In patients who require a general anaesthetic for computed tomography scanning there should be provision to proceed to operative intervention if required under the same anaesthetic (Baring and Hilmi, 2011).

Cavernous sinus thrombosis should be considered early in any patient with signs of bilateral lid swelling or ptosis, proptosis, deep retro-orbital pain, gross ophthalmoplegia, papilloedema or signs of meningeal irritation. A magnetic

resonance venogram is the most useful modality for diagnosis of cavernous sinus thrombosis (Fokkens et al, 2012).

Management

Orbital cellulitis is a medical emergency and requires early involvement of a number of medical specialties. All patients need a review from an otolaryngologist and ophthalmologist. Immediate resuscitation of the patient should be carried out as per any septic patient.

Systemic treatment

Antibiotics

Intravenous antibiotic therapy is the mainstay of medical management. The most common organisms are streptococcal and staphylococcal species and empirical treatment should be aimed at these organisms.

Broad-spectrum antibiotics against Gram-positive cocci organisms are most commonly used. Antibiotics with adequate blood–brain barrier penetration to reach the CNS are useful to cover any patient at risk of neurological complications.

For most infections a beta-lactam antibacterial combined with a beta-lactamase inhibitor is appropriate, e.g. amoxicillin + clavulanic acid or piperacillin + tazobactam. This will provide broad aerobic and anaerobic organism cover. Penicillins have good CNS penetration especially when administered intravenously. The CSF penetration of cephalosporins varies greatly but ceftriaxone, cefotaxime and ceftazidime have adequate penetrance while macrolides and clindamycin have poor penetrance. Metronidazole can be added if specific anaerobic cover is required (Brook, 2009; Sullins and Abdel-Rahman, 2013).

In cases of meticillin-resistant *S. aureus*, combination treatment using vancomycin plus a cephalosporin with good CSF penetration should be considered (Brook, 2009; Seltz et al, 2011; Lei et al, 2013). In immunocompromised patients or those with significant comorbidities, antimicrobial choice should be closely discussed with the local microbiologist.

Where appropriate a surgical specimen, tissue or aspirate for culture is important to guide appropriate antibiotic treatment. Choice of antibiotic should be guided by local sensitivities, hospital policies and advice of a microbiologist. The duration of antibiotic therapy is under debate and should be guided by the patient's clinical and biochemical progression during his/her hospital stay.

The length of oral antibiotic use on discharge is also contentious and should be guided by the isolated organism and advice from the microbiologist. Most studies advocate the use of oral antibiotics for 7–14 days on discharge (Nageswaran et al, 2006; Bedwell and Bauman, 2011; Moubayed et al, 2011).

Local treatment

Nasal decongestants, e.g. oxymetazoline or ephedrine, and topical corticosteroid therapy are indicated to dampen the inflammation and oedema within the nasal airway and thus facilitate sinus drainage. Topical antibiotic creams and lubricants may be indicated in patients with significant conjunctival chemosis and proptosis to avoid secondary exposure keratopathy.

Surgery

In the presence of an abscess the role of antibiotics as a sole therapy diminishes. Indications for surgical intervention in orbital complications are:

1. Radiological evidence of subperiosteal or intraorbital abscess on computed tomography or magnetic resonance imaging
2. Reduced visual acuity or colour vision, presence of relative afferent pupillary defect or inability to assess vision
3. Progressive or resistant infection after 48 hours of intravenous antibiotics
4. Decline in systemic health after 48 hours of intravenous antibiotics (Fokkens et al, 2012).

Surgical treatment for such complications involves an external or endoscopic surgical drainage. The choice of technique will depend upon the particular expertise of the surgeon and access. For example, an endoscopic approach may be difficult in a very inflammed, oedematous nasal airway where access is poor as a result of the nasal anatomy (Fokkens et al, 2012). During endoscopic surgery, performing associated maxillary antrostomies and ethmoidectomy is indicated as well as drainage of the abscess. Extended sinus surgery should be performed as indicated on an individual case basis. External approaches include retrocaruncular orbitotomy or skin approaches such as a Lynch incision.

There is debate regarding medical *vs* surgical treatment of subperiosteal abscesses in paediatric patients. The literature suggests that paediatric patients presenting with impaired visual acuity, elevated intraocular pressure, ophthalmoplegia, proptosis ≥5 mm or with large abscesses (width >10 mm) are best treated surgically (Bedwell and Choi, 2013). Older patients may not respond as well to medical intervention alone.

Other treatments

Surgical drainage of the abscess will release the pus but the inflammation associated with the orbital cellulitis can last for several weeks. Corticosteroids can reduce the oedema, the cytotoxic effects of inflammation and the long-term scarring resulting from fibroblast proliferation. Pushker et al (2013) studied the role of corticosteroids in adults with orbital cellulitis. Patients were given a tapering dose of oral corticosteroid from day 4 post-commencement of treatment with antibiotics. They found that use of oral corticosteroids reduced hospital stay with earlier resolution of inflammatory symptoms.

Yen and Yen (2005) found that intravenous corticosteroids might be beneficial during the acute treatment of paediatric patients with orbital cellulitis and subperiosteal abscess. However, further randomized control trials are warranted.

KEY POINTS

- Orbital cellulitis is a medical emergency that involves early multidisciplinary management.
- A focused history and examination allows assessment of severity of disease.
- Contrast-enhanced computed tomography scanning of the sinuses and orbit is the gold standard investigation in appropriate cases.
- Mainstay of medical treatment is intravenous antibiotics, nasal decongestants and analgesia.
- Presence of subperiosteal abscess and orbital abscess normally requires surgical drainage.
- Young children with a small subperiosteal abscess may not require immediate surgical drainage.

Conclusions

Orbital cellulitis is a medical emergency requiring the urgent involvement of a multidisciplinary team. Primary assessment by clinicians should establish the need for further imaging to rule out the presence of an abscess. Early appropriate management of patients will lead to reduced morbidity.

Primary care doctors and hospital physicians should be able to accurately identify such patients and an early and urgent referral to an ear, nose and throat surgeon and ophthalmologist is imperative.

Indications for surgery include the presence of decreased visual acuity, inability to assess vision, deteriorating orbital signs and a failure to respond to antibiotic treatment in presence of an orbital or subperiosteal abscess. **BJHM**

Conflict of interest: none.

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