Diagnosis, management and treatment of orbital and periorbital cellulitis in children

Fatima Rashed and colleagues say emergency department nurses should be on high alert when children present with eye problems and should look for red flag features during triage

Abstract

Children with red swollen eyes frequently present to emergency departments. Some patients will have orbital cellulitis, a condition that requires immediate diagnosis and treatment. Orbital cellulitis can be confused with the less severe, but more frequently encountered, periorbital cellulitis, which requires less aggressive management. Delayed recognition of the signs and symptoms of orbital cellulitis can lead to serious complications such as blindness, meningitis and cerebral abscess. This article describes the clinical features, epidemiology and outcomes of the condition, and discusses management and treatment. It also includes a case study.

Keywords
orbital cellulitis, children, antibiotics, sinusitis, meticillin-resistant *staphylococcus aureus*, blindness, periorbital cellulitis

Although relatively uncommon, orbital cellulitis is associated with severe ocular and intracranial complications that can lead to blindness, meningitis and death (Cohen 2011), therefore early identification and management is vital (Smith et al 2014). It can be difficult in practical terms to differentiate between periorbital and orbital cellulitis at initial presentation, particularly when the tissues are very swollen and the eye cannot be visualised. Therefore, clinicians should maintain a high level of suspicion for orbital cellulitis.

ED nurses are often the first healthcare professionals to triage children, and should be aware of these conditions. If orbital cellulitis is suspected, it should be considered an ocular emergency, children should be triaged in an urgent category, and medical and ophthalmological assessments should be arranged immediately (Napierkowski 2013).

Pathophysiology and clinical features
Orbital cellulitis is an invasive bacterial infection of the deep postseptal tissues of the eye (Fanella et al 2011), and usually arises secondary to paranasal sinus disease (Murphy et al 2014). In contrast, periorbital cellulitis is a superficial infection involving the external structures anterior to the septum and eyelids, and usually arises from local trauma or local infection (Mathew et al 2013). Occasionally, periorbital cellulitis can spread past the septum and develop into orbital cellulitis.

The Chandler system is used to categorise periorbital and orbital cellulitis into five stages, according to the anatomical location and severity of the infection (Upile et al 2012). Each stage does not necessarily progress to the next. The stages are:
Stage 1: preseptal cellulitis. Inflammation does not extend past the orbital septum.

Stage 2: postseptal cellulitis. Inflammation extends into orbital tissues, with no abscess formation.

Stage 3: subperiosteal abscess. Abscess forms deep into periosseum of the orbit.

Stage 4: orbital abscess. Abscess forms in the orbit.

Stage 5: cavernous sinus thrombosis.

In orbital cellulitis, raised pressures, resulting from inflammation in the postseptal space, increase the risk of central retinal artery or vein occlusion, or damage to the optic nerve. This can increase the risk of retinal and optic nerve ischemia, which can lead to blindness within two to three hours (Hytönen et al. 2015). This highlights the need for immediate identification and management of children who present with the condition. Box 1 summarises the clinical features of periorbital and orbital cellulitis.

Epidemiology and risk factors

The exact incidence of periorbital and orbital cellulitis is unclear as there is little published data on the number of cases in the whole population (Murphy et al. 2014). However, there are recognised risk factors in children, including the following:

- Recurrent sinus infections, particularly in children with ethmoid sinusitis, as the thin medial orbital wall is the only structure that lies between this air space and the orbit, which allows retrograde spread of infection (Mathew et al. 2013, Napierkowski 2013).
- Recent head or facial injuries.
- Recent insect bites, which can be a point of entry for bacteria.
- There appears to be a higher incidence in boys than girls, and some authors suggest the incidence in boys is double that of girls (Oxford and McClay 2005, Nageswaran et al. 2006).

Before the 1992 introduction of the Haemophilus influenzae serotype b vaccine (Hib) in the UK, this organism was the leading cause of orbital cellulitis in children (Sharma et al. 2014). Since introduction of the vaccine, however, there has been a rise in the frequency of infections caused by Staphylococcus and Streptococcus species (Sharma et al. 2015). Migrant children who might not have been immunised, and those born in the UK but who are not fully immunised, are still at increased risk of Hib infection.

A US study (Seltz et al. 2011) reported recovery of a true pathogen in 31% of the 94 children involved who had positive cultures (median age 17 months, 64% males). Streptococcus anginosus was the most commonly grown organism from sinus/orbit cultures in 14 of the children, followed by meticillin-sensitive Staphylococcus aureus in seven of the children. Blood cultures were positive in only three children, and the isolated organisms were Staphylococcus aureus (n=1), Haemophilus influenzae (n=1) and meticillin-resistant Staphylococcus aureus (MRSA) (n=1). Another US study reported 15 cases of MRSA paediatric orbital cellulitis, which highlights an increase in this causative agent (Mathias et al. 2012).

Murphy et al. (2014), in a one-year prospective observational study using the Scottish Ophthalmic Surveillance Unit reporting system, identified 15 children with orbital cellulitis, which translates as an incidence of 1.6 per 100,000 children. The study found that seven (47%) of these children had a preceding upper respiratory tract infection, 13 (87%) had radiological evidence of sinus disease,
and 15 (100%) needed surgical intervention. The most commonly identified organisms were *Streptococcus* (66%) and *Haemophilus* species (46%).

More recently, a Canadian study (Sharma et al 2015) of 149 patients aged less than 18 found that 101 (mean age seven years, 75% males) had true orbital cellulitis. Thirty of these patients required surgical drainage, and abscess fluid was analysed for microbiological confirmation yielding 18 positive results. Four of the 18 had Hib-positive culture, one of whom had pure growth while three had mixed growth. Of the 68 patients who had blood cultures taken, only three (4.4%) had positive cultures, and the pathogens identified were *Streptococcus pyogenes* (*n*=1) and coagulase-negative *Staphylococcus* (*n*=2).

**Local audit**

In 2010, a retrospective outcome audit study was conducted in Yeovil District Hospital involving all patients aged 0 to 17 diagnosed with either periorbital or orbital cellulitis over the preceding ten years. Fifty children who had presented between January 2000 and December 2009 were identified. Using the local microbiology record system, isolated organisms were identified, and patients’ clinical notes were reviewed to gather further information.

Of the 50 patients included in the audit, 42 (84%) had periorbital cellulitis and eight (16%) had orbital cellulitis. This translates as an estimated incidence of 15 per 100,000 children with periorbital cellulitis, and 2.8 per 100,000 children with orbital cellulitis. The conditions were most commonly identified in children aged one to seven (54% *n*=27), with 28% (*n*=14) occurring in those aged over seven, and the remaining 18% (*n*=9) in those under one year. Peak incidence was between December and February, during which 23 of the 50 children (46%) presented.

The causative organisms identified were *Micrococcus* (*n*=1) and *Staphylococcus aureus* in eye swabs (*n*=3). None of the children had positive blood cultures. All 50 children received antibiotics, 22 (44%) had orbital imaging, while five of the eight children with orbital cellulitis (63%) required orbital abscess drainage.

After completion of the audit, local management guidelines were modified to focus on clinicians’ need to be aware of orbital cellulitis and to raise immediate concerns if the condition is suspected, the need to administer antibiotics early, and the need for early involvement of ear, nose and

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**Box 2 Features suggestive of orbital cellulitis during clinical examination**

- Look for signs and symptoms of intracranial spread and, if these are suspected, request immediate imaging. Signs and symptoms include severe eyelid swelling (Figure 3), altered level of consciousness, and signs of systemic sepsis or meningitis
- Unable to move eyeball when asked to follow an object or light. This can be difficult to see with a grossly swollen eyelid, however eyeball movement should be evident under the closed eyelid in periorbital cellulitis
- Painful eye movements
- Proptosis (Figure 3)

**Box 3 Red flags in children who present with symptoms suggestive of orbital cellulitis**

- Proptosis
- Reduced visual acuity, especially if unilateral
- Conjunctival oedema
- Limited, painful, or reduced eye movements
- Impairment or abnormal colour vision
- Relative pupillary defect
- Systemic features including fever or neurological compromise
throat (ENT) and ophthalmology specialists (Amin et al 2012).

In the post-Hib vaccine era, bacteraemia and sepsis are rarely seen in acute orbital infections (Seltz et al 2011, Murphy et al 2014, Sharma et al 2014), but health professionals should be aware of these risk factors when triaging children.

**History and examination**

Differentiating between orbital and periorbital cellulitis can be difficult at first, as initial clinical examination can reveal similar findings. Children with either condition are likely to present with unilateral periorbital oedema and erythema, and might complain of recent rhinorrhea, difficulty opening the eye, or excessive tearing, so these findings alone cannot be used to distinguish between the two conditions.

Children with periorbital cellulitis may have a history of recent insect bite or trauma to the facial skin (Ambati et al 2000). The potential spread and progression to orbital cellulitis should be at the forefront of clinicians’ minds and treatment should not be delayed. Box 2 lists some features clinicians should consider during examination that can raise suspicion of orbital cellulitis, while Box 3 summarises red flags for triaging children who present with red swollen eyes.

**Differential diagnosis**

Inflammation of the tissues around the eye is a common feature of various conditions (Welkoborsky et al 2015). Orbital cellulitis, in which orbital inflammation is a sign, is uncommon but can be life threatening. If children receiving treatment for suspected orbital cellulitis do not show improvement with close monitoring, clinicians should consider other causes of orbital inflammation (Table 1), as misdiagnosis is common (Fozard et al 2011).

**Investigations**

It can be difficult to examine children with swollen eyelids and this, combined with the challenge of making a definitive diagnosis, means that radiological imaging is often required. If ophthalmic examination reveals decreased visual acuity, proptosis, ophthalmoplegia and/or diplopia, then urgent imaging of orbits and sinuses is required (Buchanan et al 2012).

Computed tomography (CT) scan is used to diagnose orbital cellulitis as it allows rapid and accurate clinical staging of the condition to guide treatment decisions (Le et al 2014). Magnetic resonance imaging (MRI) can also be used to help differentiate between periorbital and orbital disease, but can be practically difficult to undertake in younger children, and is not always available in smaller centres. The lack of radiation in MRI scans is of significant consideration in paediatric populations.

Blood tests including full blood count and C-reactive protein are often performed, and although they may be of limited diagnostic value, they can be useful for monitoring patients’ progress. Blood cultures and eye swabs can be taken, but seldom yield microbiologically diagnostic results (Seltz et al 2011, Sharma et al 2015).

**Management**

If there is suspicion of periorbital or orbital cellulitis, children should be referred rapidly for comprehensive paediatric assessment and management, with further input from ophthalmology and, in some cases, ENT specialists. An urgent CT scan should be carried out if orbital cellulitis or its associated complications are suspected (Buchanan et al 2012). Eye swabs can help direct antibiotic cover, but antibiotic treatment should not be delayed while waiting for swab or blood culture results.

Intravenous (IV) or oral antibiotics can be administered to children with periorbital cellulitis depending on clinical severity (Napierkowski 2013). In periorbital cellulitis, oral co-amoxiclav, reviewed after 48 hours, can be given when children are systemically well, and there is no evidence of

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**Table 1** Systemic conditions to consider in the differential diagnosis of children who present with orbital inflammation

<table>
<thead>
<tr>
<th>Cause</th>
<th>Symptoms*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allergic conjunctivitis (bacterial or viral)</td>
<td>Sudden onset of bilateral eyelid swelling, excessive tearing and conjunctival injection. Itching may be present. Normal visual acuity</td>
</tr>
<tr>
<td>Idiopathic orbital inflammatory disease</td>
<td>Sudden onset painful and swollen eyelid, commonly bilateral in children with anterior or posterior uveitis. Diplopia may occur</td>
</tr>
<tr>
<td>Thyrotoxicosis</td>
<td>Change in appearance of eyes, usually bulging. Dry or watery eyes, may feel like grit in eye. Red eyelids and eyes. Photophobia, blurred vision, difficulty moving eyes. Systemic features of overactive thyroid may be present</td>
</tr>
<tr>
<td>Contact dermatitis</td>
<td>Itchy, stinging eyelids which may be red and swollen. Conjunctival injection may occur. Allergic predisposition may be known</td>
</tr>
</tbody>
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* Symptoms listed might not all be apparent at presentation

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Case study

A ten-month-old boy presented to an emergency department (ED) with a swollen right eye (Figure 2). The eye had been ‘slightly puffy’ when he woke up that morning, but over the day the swelling around the eyelid had increased. He was otherwise completely well.

The baby had symptoms of a cold for the past four weeks with a ‘snotty’ nose, but in the week leading up to presenting at the ED he was reported to be well. There was no history of facial trauma, insect bites or foreign body injury to the eye. Initial observations were a respiratory rate of 26 breaths per minute, oxygen saturations 98% in air, heart rate 130 beats per minute, temperature 37.5°C, and paediatric Glasgow Coma Score 15. He was warm and well perfused.

At initial presentation, the swelling was preventing his right eye from opening fully, and there was some discharge present. The left eye was normal. Despite limited opening of the right eyelid, full range of non-painful eye movements in both eyes were noted. His right eye was not tender on palpation and the conjunctiva was not inflamed. A diagnosis of periorbital cellulitis (Figure 2) was made.

The baby was started on chloramphenicol eye drops four times daily for three days, and oral co-amoxiclav for seven days. An eye swab was sent for microscopy, culture and sensitivity. A plan was made for follow up in 24 hours if there was no improvement in his condition. At follow up the next day, the baby’s respiratory rate was 24 breaths per minute, oxygen saturations 96% in air, and temperature 37°C. He appeared clinically well and was ‘happy and smiling’. The infant was admitted and started on intravenous ceftriaxone and flucloxacillin.

A plan for computed tomography scan, with ophthalmology and ear, nose and throat specialist opinion, was recorded in the clinical notes in case the baby deteriorated and showed signs of developing orbital cellulitis (Watkins 2006, Napierkowski 2013). Oral paracetamol and ibuprofen were administered as required.

Over the next 72 hours, the periorbital swelling continued to improve. Paediatric early warning score was undertaken regularly throughout his admission. His observations remained stable and he was apyrexial. After three days of intravenous antibiotic treatment, the baby showed clinical improvement, and was discharged home on oral co-amoxiclav for a further five days.

His parents were reassured and given information leaflets about the condition, informed about the signs and symptoms of deterioration and the features of evolving orbital cellulitis, and were asked to bring him back if they suspected he was deteriorating. Telephone follow up one week later confirmed complete resolution of his symptoms.

Orbital cellulitis. An alternative antibiotic such as a macrolide can be used for children with penicillin allergy.

For children with orbital cellulitis but no abscess, IV antibiotics should be given. If an abscess has formed, further anaerobic cover is needed, and surgical drainage may be indicated (Erickson and Lee 2015).

The paediatric unit at Yeovil uses triple antibiotics, IV cefotaxime, flucloxacillin and metronidazole, for treating children with orbital cellulitis. If children are allergic to penicillin, then clindamycin and ciprofloxacin can be administered, and if MRSA is suspected or isolated, then appropriate cover with vancomycin is necessary. When culture results are available, antibiotic therapy will be guided by sensitivities and local policies.

All children must be closely monitored with regular observations, and reassessment. Repeat CT scans are needed in those whose condition deteriorates or does not improve after 48 hours of medical therapy, with the possibility of surgical intervention (Bedwell and Bauman 2011).

**Prognosis and complications**

Early diagnosis and effective intervention in children with orbital and periorbital cellulitis are essential to limit the risk of long-term complications and mortality. Before the advent of antibiotics, mortality due to orbital cellulitis was as high as 17%, while 20% of patients lost sight in the affected eye (Cohen 2011). Although mortality rates have reduced to less than 2.5%, blindness still occurs in 11% of children, so early identification and immediate intervention is vital (Cohen 2011).

Factors such as older age, diplopia at presentation, and admission through EDs were predictors of complications that will require surgical
intervention (Mahalingam-Dhingra et al 2011). These complications include:

- Abscess formation, which can be associated with orbital cellulitis.
- Blindness if diagnosis is delayed.
- Cavernous sinus thrombosis. This has similar presenting features to orbital cellulitis, which increases the diagnostic challenge.
- Intracranial infections, including meningitis, subdural empyema, and extradural and intracerebral abscesses.
- Recurrent periorbital cellulitis. This is defined as three periorbital infections in one year with at least one month between attacks (Hauser and Fogarasi 2010).

Role of emergency department nurses

Nurses in EDs are often the first clinicians to assess children, and should be aware of the signs and symptoms of periorbital and orbital cellulitis. They should also do the following:

- Triage children with signs and symptoms of orbital cellulitis in an urgent category.
- Assess eye movements, visual acuity and, when practical, colour vision.
- Closely monitor children using paediatric early warning score. This is essential for identifying deterioration in children who may need urgent imaging and surgical intervention.

- Identify children at risk of orbital cellulitis or associated complications.
- Reassure and provide explanation to parents, particularly if children are diagnosed with periorbital cellulitis which is treated with oral or IV antibiotics.
- Arrange for safe transport to neuroimaging department, or to specialist centres if orbital cellulitis requires surgical intervention.

Conclusion

Orbital and periorbital infections can be difficult to differentiate, but orbital cellulitis in the paediatric population can lead to serious and life-threatening complications. Most children with periorbital cellulitis are treated with antibiotics to prevent progression to orbital cellulitis.

Clinicians should maintain a high degree of suspicion for the signs and symptoms of orbital cellulitis in children who present to EDs with eye problems, and be alert for red flag features during triage. Health professionals should be able to recognise symptoms quickly, as prompt intervention is associated with improved outcomes and prognosis.

References


