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Fifteen-minute consultation: Pre-septal and Orbital cellulitis

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Clinical scenario

"It is midnight and you are called to see a thirteen-year-old boy who has been brought to the paediatric emergency department with a 24-hour history of swelling and redness of his left eye. He has had a "runny nose" for a couple of days. He is systemically well. His upper and lower lids are red and swollen such that his eye is not open fully, though you elicit normal eye movements when you open his eye. Pupils are equal and reactive with no afferent pupillary defect. Visual acuity and colour vision are normal on examination."

In this article we consider the approach to pre-septal and orbital cellulitis in children including the initial assessment and management options.

Introduction

Periorbital infection is a relatively common presentation in children [1,2,3]. The majority of periorbital infections are confined to the tissues anterior to the orbital septum (pre-septal cellulitis). With prompt and effective treatment, these infections typically resolve quickly with no sequelae. A minority of infections however, extend beyond the orbital septum and represent a threat to vision as well as the potential for intracranial extension with meningitis, cerebral abscess formation and cavernous sinus thrombosis [1-4]. These rare, but serious, complications are often cited as reasons for aggressive management of all periorbital infections. (Figure 1)

Figure 1. The right eye in sagittal section, with structures of the orbital septum within blue markings

Pre-septal vs orbital cellulitis

Pre-septal cellulitis is infection of the eyelids and periorbital soft tissues anterior to the septum and thus not involving the globe or orbit (see Fig. 1 and 2). It is commonly caused by extension of paranasal sinus infections, though can be caused by spread of local soft tissue infection which may be due to trauma, insect bites, skin infections or eyelid lesions [5].

Other less serious conditions, such as conjunctivitis, can mimic early pre-septal cellulitis. A detailed history and examination as outlined below and in table 1 is essential.

Orbital cellulitis is an ophthalmic emergency that can cause sight- or life-threatening complications. The infection extends posterior to the septum, leading to the development of subperiosteal collections (Figure 3). This may exert a mass effect leading to local complications such as orbital nerve compression and can extend intra-cranially [4]. Orbital cellulitis is most commonly caused by extension of paranasal sinusitis, particularly from the ethmoid sinus. The features indicative of orbital cellulitis are outlined below and in table 1.

Aetiology

Historically, *H. influenzae* type B (Hib) was a common cause of orbital cellulitis and associated complications such as meningitis and bacteraemia. The introduction of the Hib vaccine has dramatically reduced this [6]. Sinusitis is the commonest route of infection in children and accordingly the organisms involved include *Streptococcal* species, *Staph. aureus* and anaerobes. In immunocompromised patients, fungal infection and *Pseudomonas* should be considered.

Note that pre-septal cellulitis can occur in the neonatal period, but an eye with hyperaemia and chemosis in the neonate raises the prospect of neonatal conjunctivitis (ophthalmia neonatorum), which has a different spectrum of infective causes due to vertical transmission. The management of these infections in the neonate will invariably include intravenous antibiotics. The investigation and treatment of neonatal conjunctivitis is not considered further here.

Clinical assessment

Children who present with periorbital swelling and erythema require a focused history and thorough examination to determine if they are systemically well and if the infection is localised to the pre-septal region or has extended beyond the orbital septum [2, 5, 7, 8].

Salient features of history and examination are outlined below:

History

- Age
- Symptoms:
 - Onset of redness and swelling
 - Pain on eye movement
 - Reduced visual acuity
 - Headaches
 - Fever
 - Neurological e.g. altered level of consciousness
 - Recent illness e.g. sinusitis or other upper respiratory infection, dental
- Eye problems e.g. sty, chalazion, dacrocystitis, trauma or recent surgery [8]
- Vaccination status (particularly Hib) [6]
- Comorbidities e.g. immunocompromised [9], diabetes mellitus

Examination

- General appearance (Toxic vs well)
- Vital signs
- GCS
- Neurological examination in the child with reduced GCS, headaches or other symptoms of meningitis
- Eye
 - Eyelid (extent of erythema and swelling)
 - Conjunctiva (redness, chemosis)
 - Sclera
 - Pupils (size, reactivity, specifically looking for relative afferent pupillary defect (RAPD))
 - Vision (fields, acuity, colour)
 - Eye movements (pain, ophthalmoplegia)
 - Proptosis
 - Fundoscopy (specifically for optic nerve swelling, venous tortuosity) [12]

Figure 2. Pre-septal cellulitis (left eye) with mild upper lid swelling and erythema

Figure 3. Orbital cellulitis (right eye) with severe lid erythema and proptosis

The examination findings indicative of pre-septal cellulitis are outlined in table 1. If a child has **ANY** features suggestive of orbital cellulitis then treatment should be initiated and an urgent ophthalmology review requested. Children with orbital cellulitis are at risk of significant morbidity as outlined in table 2. In practice, it can be difficult to examine an eye that is swollen to the point of being difficult to open. In these children it is prudent to treat as suspected orbital cellulitis until proven otherwise [13].

Pre-septal cellulitis	Orbital cellulitis
Possible to open eye sufficiently to examine it	If unable to open eye sufficiently to examine it – high index of suspicion of orbital cellulitis
Erythematous lid(s) and/or surrounding eye	Erythematous lid(s) and/or surrounding eye
Normal vision	Vision impaired e.g. reduced acuity, loss of red colour perception
White eye	Injected conjunctiva/sclera, chemosis
Extra-ocular movements normal and painless	Painful or impaired eye movements
No proptosis	Proptosis
Normal pupils	Asymmetrical pupillary reactivity, RAPD
Systemically well	Usually systemically well but may show signs of systemic upset and fever

Table 1. Examination features of pre-septal vs orbital cellulitis (not all signs will be present in orbital cellulitis, but diagnosing pre-septal cellulitis clinically will depend on the *absence* of any of these features) [2, 4, 10-12]

Complications	Important clinical features
Eye Visual loss secondary to: <ul style="list-style-type: none"> • Optic neuritis • Orbital nerve ischaemia secondary to orbital vein thrombosis or compression effect 	Relative afferent pupillary defect Rapid deterioration in vision in the affected eye Impaired red colour perception Optic nerve oedema on fundoscopy
Intracranial Epidural or subdural abscess Cavernous sinus thrombosis	Headache Vomiting Change in mental state Seizures

Table 2. Eye- and Life-threatening complications of orbital cellulitis [4, 6, 12, 13]

Investigation

- A child with pre-septal cellulitis who is systemically well may not require any investigations.
- If there is a suspicion of orbital cellulitis, **contrast-enhanced CT orbits and sinuses** should be performed (see Table 3) [14].
- For a child with orbital cellulitis and neurological deficit, MRI brain and orbits would be the gold standard [1], as soft tissue disease including intracranial abscess and cavernous sinus thrombosis would be two key differentials; in practice, urgent MRI may be limited by availability and the need for sedation or general anaesthesia for scanning in children. CT brain in addition to orbits and sinuses would be appropriate in such instances.
- If there is a suspicion of sepsis or meningitis, then standard protocols for sepsis can be followed [15], and investigations such as blood cultures, full blood count, CRP and lumbar puncture should be performed. (see <https://www.nice.org.uk/guidance/ng51/resources> [16]) In practice, it is likely that any child subsequently treated with IV antibiotics will have a set of bloods taken, but this need not include blood cultures unless systemic infection is suspected. A full blood count will show elevated white cell count with left shift, but this does not distinguish orbital from pre-septal cellulitis.
- Swabs for MC&S from conjunctiva, existing external or surgical wounds, nasopharynx or at surgery may subsequently guide antibiotic therapy.

Indications for contrast-enhanced CT orbits/sinuses
Proptosis Ophthalmoplegia Inability to assess globe due to swelling of lids No response to treatment or swinging pyrexia after 48 hours of IV antibiotics Relative afferent pupillary defect* Reduced visual acuity* Reduced red colour discrimination* Neurological symptoms, signs⁺
*Imaging should not delay intervention if there is a possibility of orbital compartment syndrome
⁺ Should also include brain imaging (MRI preferable if it does not delay imaging)

Table 3: Indications for imaging in periorbital infection [1, 2, 12, 14]

Treatment

Antibiotics

The mainstay of treatment for periorbital infections is empiric broad-spectrum antibiotics. Swab cultures will be positive less than 33% of the time [17] and as such empiric treatment targeted at the commonest causative organisms, *Staph. aureus* and *Strep. pneumoniae*. In orbital cellulitis, antibiotics should cover anaerobic sinus infections and have good CSF penetrance given the risk of intracranial spread. [1, 2, 10, 11, 12]

A child with mild pre-septal cellulitis who is systemically well could potentially be managed in the community with oral antibiotics. This, however, remains controversial with variations in practice between centres. Local antimicrobial policies vary but a suitable first line antimicrobial would be co-amoxiclav.

If a child is treated with oral antibiotics in the community they need a clear plan for follow up with a low threshold for changing to intravenous antibiotics, particularly if they are not improving within 48-72 hours of treatment or if they develop any features suspicious of orbital cellulitis.

If there is doubt as to the severity of pre-septal cellulitis or in a child with orbital cellulitis then intravenous antibiotics should be commenced. Empiric treatment with ceftriaxone will give suitable broad-spectrum cover with good CSF penetrance. In the child with orbital cellulitis or pre-septal cellulitis in the presence of sinus infection, the addition of metronidazole would be appropriate for anaerobic cover.

Disposition

Children with pre-septal cellulitis who are treated with oral antibiotics can be discharged with safety-net advice and follow up. This should include clear advice to re-attend if the child's clinical condition worsens or if there is no improvement at 48-72 hours. Arranging follow up either with the child's general practitioner or at a hospital clinic is good practice. However, sufficient and clear safety netting advice should ensure that those in need of escalating treatment re-attend at the right time.

All cases of suspected orbital cellulitis require an urgent ophthalmic assessment. Any child with orbital cellulitis and sinusitis, or sub-periosteal abscess, should be seen by an ENT surgeon, as these children may require surgical intervention.

Children requiring parenteral antibiotics will, at least initially, require admission under the joint care of Paediatrics and Ophthalmology (plus ENT if there is orbital cellulitis) If it is available, ambulatory IV therapy is safe and cost-effective in children with simple pre-septal cellulitis [18], though it is worth considering whether such patients could be managed with oral antibiotics.

Summary

In children with periorbital infection it is crucial to distinguish between pre-septal and orbital cellulitis. If this cannot be done clinically, or there is definite orbital cellulitis, contrast-enhanced CT is the investigation of choice. In children with mild pre-septal cellulitis, who are systemically well, oral antibiotics in the community can be considered.

Any child with orbital cellulitis requires IV antibiotics, and management by a multidisciplinary team (including ophthalmologists and ENT surgeons).

Questions

1. A 3-year-old child presents with a significant right eyelid oedema and redness with proptosis. He has a fever of 39c and is unable to open his right eye.

Which of the following is the best empirical treatment?

- A) IV Ceftriaxone
- B) IV Co-amoxiclav
- C) Oral Co-amoxiclav
- D) IV Metronidazole
- E) IV Cefuroxime

(A)

2. Which of the following are complications of orbital cellulitis?

- A) Blindness
- B) Meningitis
- C) Cerebral abscess
- D) Cavernous sinus thrombosis
- E) All of the above

(E)

3. In a child with suspected orbital cellulitis without neurological deficit which is the most appropriate imaging strategy?

- A) CT Brain (Unenhanced)
- B) CT Brain (Contrast-enhanced)
- C) MRI Brain
- D) CT Orbit

E) CT Orbit and Sinuses (Contrast-enhanced)
(E)

4. Which of the following organisms is most commonly associated with pre-septal cellulitis in the UK?

- A) Haemophilus Influenza B
- B) Streptococcal spp.
- C) Pseudomonas
- D) Neisseria Meningitidis
- E) Chlamydia

(B)

5. Which of the following are signs of impending orbital nerve ischaemia? (Select all that apply)

- A) Fever > 38.5C
- B) Rapid deterioration of visual acuity
- C) Loss of red colour discrimination
- D) Proptosis
- E) Relative afferent pupillary defect (RAPD)

(B, C, E)

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