Preseptal and Orbital Cellulitis

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Preseptal and orbital cellulitis are infections of the soft tissues of the orbit that can occur in both children and adults. In preseptal cellulitis, infection is limited to the area anterior to the orbital septum, whereas orbital cellulitis affects the tissues posterior to this anatomic landmark. These infections are most commonly caused by *Haemophilus*, *Staphylococcus*, and *Streptococcus* species; however, with immunization against *H. influenzae* type B (Hib), infection with this organism is becoming less common.[1–3] Peak occurrence in children has been reported at ages 2 to 4 years.[4,5] In retrospective analyses of hospitalized pediatric patients, most patients had preseptal cellulitis (85%–95%) as compared with orbital cellulitis (5%–15%).[1,2,4,6,7]

Patients with preseptal or orbital cellulitis present with similar symptoms, such as eye pain, periorbital swelling, and/or fever. It is important to differentiate between the 2 infections because the treatment for each is different, with orbital cellulitis warranting a more aggressive approach that includes parenteral antibiotics and surgical consultation. If left untreated, complications of preseptal and orbital cellulitis include blindness, meningitis, and death.[8] This article reviews the clinical presentation of preseptal and orbital cellulitis, how to differentiate between the 2 infections, and appropriate management strategies to prevent complications.

TAKE HOME POINTS

- Preseptal cellulitis is more common than orbital cellulitis.
- Eye pain, periorbital lid swelling, and fever are common symptoms of both preseptal and orbital cellulitis.
- Examination findings of proptosis and decreased extraocular movements can differentiate orbital cellulitis from preseptal cellulitis.
- Most cases of preseptal cellulitis will respond to outpatient treatment with oral antibiotics, whereas orbital cellulitis mandates hospitalization, parenteral antibiotics, radiologic imaging, and specialist consultation.
- Antibiotic treatment for preseptal and orbital cellulitis should cover both gram-positive and gram-negative infections.

ETIOLOGY

Preseptal and orbital cellulitis may result from hematogenous seeding or local spread of infectious agents[9,10]; however, local dissemination is by far the most common mechanism.[11] Initial sources of infection may be local skin trauma, penetrating trauma, or sinus infections, specifically those involving the ethmoid sinus.[5,9,10,12,13] Some authors sharply differentiate the etiologies of the infections, maintaining that orbital cellulitis develops secondary to sinusitis and preseptal cellulitis secondary to skin trauma; however, others theorize that the causes overlap based on their similar spectra of causative bacteria.[3,14] Infections can also develop as a result of surgical manipulation, indwelling foreign bodies, nasolacrimal duct dysfunction, or chronic cocaine abuse.[15–18] Nasolacrimal duct dysfunction allows for bacterial proliferation in stagnant fluid of the lacrimal sac.[15,18] Although an increase in the number of periorbital infections has not been reported in immunosuppressed patients (eg, HIV-infected patients), periorbital infections in these patients may be more persistent or have more adverse outcomes.[19]

Agents that cause preseptal and orbital cellulitis include those associated with sinusitis and skin infections, namely *H. influenzae*, *S. pneumoniae*, *Moraxella catarrhalis*, *S. aureus*, *S. pyogenes*, coagulase-negative *Staphylococcus* species, α- and β-hemolytic *Streptococcus* species, and *S. viridans*.[1,2,4,6–8,13,18,20–22] Bacteria may coexist with viral infection.[23] With chronic sinusitis, infections are more likely to be polymicrobial.[9] Rare causative agents include *Pseudomonas aeruginosa*, *Neisseria gonorrhoeae*, *Treponema pallidum*, *Mycobacterium tuberculosis*, *Bacteroides* species, and fungal infections.[9,19,20,24] Fungal infections

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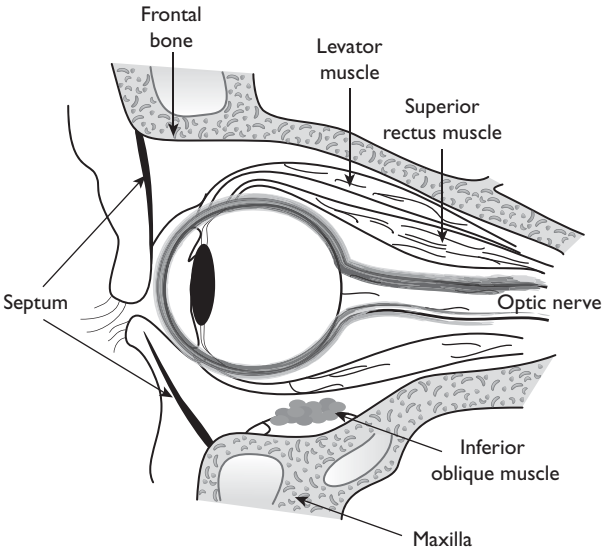

Figure 1. Anatomy of the orbit (sagittal view).

due to aspergillosis or mucormycosis may occur after use of antibiotics, in the setting of immunosuppression, or with a penetrating injury.[9,11,15,19] Aspergillosis has also been associated with marijuana use.[19,25] Although blood cultures are not always obtained, organisms have been grown in 3% to 23% of patients with preseptal or orbital cellulitis. Studies evaluating patients with preseptal cellulitis demonstrated that blood cultures grew organisms in 0% to 15% of cases,[1–3,5,6,22] while studies evaluating patients with orbital cellulitis showed that blood cultures grew organisms in 7% to 50% of cases.[1–5,7]

H. influenzae historically was the most frequent cause of preseptal or orbital cellulitis,[3–6] but this has since changed with the increased rate of immunization against Hib. *Streptococcus* species are now observed more frequently in children with preseptal and orbital cellulitis.[22] The 7-valent pneumococcal vaccine may have decreased the prevalence of pneumococcal bacteremia as a cause.[14] The pneumococcal vaccine has mildly reduced the number of cases of acute otitis media[26]; however, no studies are available regarding its impact on preseptal or orbital cellulitis.

PHYSIOLOGY

The anatomy of the orbit places the periorbital tissues at risk for infection (**Figure 1**). The orbits are pear-shaped cavities that contain the orbital septum, a thin physical barrier of connective tissue separating the eyelid and the orbit. The posterior aspect of the orbit is filled with loose fatty tissue. The orbital septum originates from the periosteum of the skull and inserts onto the eyelids to create the preseptal and orbital spaces and is contiguous with the periosteum of the orbital bones and dura mater surrounding the brain. In the past, infection anterior to the orbital septum was termed *periorbital cellulitis* but has since been termed *preseptal cellulitis* to reflect the underlying anatomy.

The orbits are in close proximity to the thin eyelids, the teeth, the nasolacrimal duct, and the sinuses.[8] The paranasal sinuses surround the orbit on 3 sides, branching from the nasal cavity to create the maxillary, frontal, ethmoid, and sphenoid sinuses. The lamina papyracea provides a minimal, permeable bony anatomic separation of the ethmoid sinus from the periorbital tissues.[10,14,27] Defects of any of the bony borders/walls allow for easier dissemination of infection.[10,13] The sphenoid sinus abuts the medial wall of the optic canal, and therefore infections of the sphenoid sinus may affect the optic nerve, which in turn can affect the brain. Pressure on the optic nerve may result in loss of perfusion and vision.[8] The orbital and periorbital area is drained by a highly anastomotic and valveless venous system that empties to the superior and inferior ophthalmic veins and subsequently the cavernous sinus.

Lacrimal glands secrete tears that pass over the cornea from lateral to medial and drain through the nasolacrimal duct into the nose.[15] Defenses against infection include the blink reflex, tears, lymphocyte-rich tissue under the cornea, and normal flora of the conjunctiva.[15] Fungi and *S. aureus* are intermittently present in this normal flora.[4,15]

DIAGNOSIS

Clinical Presentation

Patients with preseptal or orbital cellulitis can present with similar symptoms, and it is important to differentiate between the 2 infections. Eye pain and periorbital edema are common symptoms of both preseptal and orbital cellulitis,[10,21] and involvement is typically unilateral.[5,10] The eyelid generally is red, tender, and swollen.[6,9,16] Fever is typically present, but conjunctival hyperemia is typically absent.[5] Focal sinus region tenderness and purulent nasal discharge may be present due to sinus infections.[9] Black eschar within the nasal mucosa indicates a potential fungal infection.[9,11] If the patient has skin necrosis or bullae on the eyelids, consider necrotizing fasciitis rather than cellulitis.[28] The teeth should be examined as possible causes of infection.[4,5]

Important elements differentiate preseptal from orbital cellulitis. In preseptal cellulitis, the patient has intact extraocular movements and does not have proptosis.[9] Orbital cellulitis is marked by decreased extraocular movements, proptosis, diplopia, and decreased

vision.[3,7,10] Fever and headache may be present and may be more pronounced in orbital cellulitis.[17,19] A child may appear more toxic with orbital cellulitis, although this is not specific to orbital infection.[14] **Figure 2** illustrates 2 pediatric cases of preseptal cellulitis.

Figure 2. (**A**) A 4-year-old boy with preseptal cellulitis after an insect bite (Reprinted with permission. © Hoffman D. Dermatlas. Available at www.dermatlas.org). (**B**) A 6-year-old child with bilateral erythema and edema of the eyelids after minor trauma to the forehead marked by a scab. Proptosis was not observed. Although the patient lacked signs of orbital cellulitis, the degree of edema and erythema resulted in radiographic testing, which revealed inflammation limited to the preseptal tissues. (Reprinted with permission. © Waseem M. Dermatlas. Available at www.dermatlas.org.)

Laboratory and Imaging Studies

Computed tomography (CT) scanning may be used to evaluate for abscess formation and differentiate orbital from preseptal cellulitis.[27] In preseptal cellulitis, inflammation is limited to the area anterior to the orbital septum.[8,16] Imaging is indicated for patients with proptosis or decreased extraocular movements and in instances where inflammation precludes effective examination of the eye.[10,12,27] If these signs progress or develop despite treatment, a repeat CT is required.[10,27] Surgery is not warranted if imaging shows the absence of abscess formation or orbital cellulitis.[12,27]

With infection associated with sinusitis, CT demonstrates soft tissue mucosal thickening of the sinus cavities, sinus opacification, or air fluid levels.[9,17,19,27] An intact orbitosinus septae can be visualized to rule out an invasive or destructive process.[27] Magnetic resonance imaging is more sensitive for recognizing cavernous sinus thrombosis.[29]

A complete blood count may show leukocytosis, which may be more pronounced with orbital cellulitis.[2,13,18,19] Blood or conjunctival swab cultures of purulent material may be obtained in severe cases or in cases where the diagnosis is uncertain. If the clinical presentation findings are consistent with orbital cellulitis, blood cultures are recommended.[20] Bacteremia may reflect the orbit as the lone focus of infection or may reflect dissemination from a distal site. Aspiration of local infections outside of the orbital tissue may be performed by obliquely inserting a 25-gauge needle into the infected tissue.[5]

If necessary or if a surgical approach is taken, aspirates of abscesses or infected sinuses may be cultured.[9] Necrotic tissue can be biopsied for mucormycosis. Patients with signs of meningitis or sepsis should be treated accordingly. Lumbar puncture is indicated for those with suspected meningitis, but this is not always easily assessed in younger patients.[10,14]

Differential Diagnosis

Differential diagnoses of preseptal and orbital cellulitis include all of the inflammatory processes that affect the eye and its orbit. Working through the list of potential diagnoses along with physical examination and imaging findings can establish the correct diagnosis and an appropriate treatment plan. Infectious possibilities (in increasing degree of severity) include blepharitis, conjunctivitis, preseptal cellulitis, orbital cellulitis, endophthalmitis, cavernous sinus thrombosis, and necrotizing fasciitis.[9,10,28,30–33] Endophthalmitis is inflammation within the globe.[31] Cavernous sinus thrombosis often has bilateral involvement of symptoms.[10] Noninfectious possibilities include orbital pseudotumor, rapidly growing orbital tumor, Graves' disease, and subperiosteal hematomas; with these entities fever would typically be absent.[9,10,34]

TREATMENT

Foreign bodies should be removed.[10,16] Contact lenses should be discarded and patients should avoided wearing them acutely.[15] Important differences in treatment approaches exist between preseptal and orbital cellulitis. Orbital cellulitis mandates parenteral antibiotics, radiologic imaging, and consultation from surgical specialists, such as otolaryngologists or ophthalmologists.[10,12,14,33] Surgery may be required, with approximately half of patients responding to intravenous (IV) antibiotics.[5] Surgical approaches include both endoscopic and external methods.[8,13,33] Complications of untreated infections include periosteal and orbital abscesses, loss of vision, cavernous sinus thrombosis, and brain abscesses.[10,12,13,18,19,29] Cavernous sinus thrombosis occurs with intracranial infection and often has bilateral orbital involvement.[10] Immunosuppressed states may result in more complications and poor outcomes.[9,19]

Multiple antibiotic regimens for both preseptal and orbital cellulitis infections have been used (**Table 1** and **Table 2**). There is no consensus on the duration of therapy, and evidence for a standard regimen is lacking

Table 1. Proposed Initial Intravenous Antibiotic Regimens for Preseptal Cellulitis Requiring Hospitalization

Ampicillin[20]
Cefuroxime[10,33]
Ampicillin with sulbactam[10,12]
Ampicillin and nafcillin[27]
Ampicillin and chloramphenicol[6,20]

Data from Smith et al,[6] Lessner and Stern,[10] American Academy of Pediatrics,[12] Schramm et al,[20] Goldberg et al,[27] Howe and Jones.[33]

for both preseptal and orbital cellulitis. IV amphotericin B has been used for aspergillosis.

Preseptal cellulitis may be treated on an outpatient basis with oral antibiotics.[12] If there is no improvement within 48 hours, hospitalization, parenteral antibiotics, and specialist consultation should be considered.[12,14] Antibiotics should be specific for *H. influenzae*, *Streptococcus*, and *S. aureus*. Suggested regimens for treatment of preseptal cellulitis have included ampicillin with a penicillinase-resistant penicillin, cefuroxime, and amoxicillin-clavulanic acid (Table 1).[3,5,10,33] For children, the American Academy of Pediatrics recommends ampicillin-sulbactam or ceftriaxone with the addition of vancomycin if infection is thought to involve penicillin-resistant agents.[12] Topical antibiotics and nasal decongestants are ineffective for treating patients with preseptal cellulitis.[5,33] In patients with signs of systemic illness, consideration of meningitis and subsequent lumbar puncture, hospitalization, and parenteral therapy is warranted.[10,14]

CONCLUSION

The most important element in the care of patients with preseptal cellulitis and orbital cellulitis is differentiating the 2 infections. Preseptal cellulitis is much more common than orbital cellulitis, and patients with preseptal cellulitis can be treated as outpatients with oral antibiotics. If the globe can be examined and the patient has full gaze without pain, CT imaging can be deferred. Red flags for the more worrisome diagnosis of orbital cellulitis or abscess include proptosis and decreased extraocular movements. These signs warrant hospitalization, parenteral antibiotics that include coverage for *H. influenzae*, CT, and surgical specialty consultation. The inability to completely examine the globe for intact vision and extraocular movements also necessitates CT scanning. Treatment in both preseptal and orbital cellulitis should include coverage of *Haemophilus* species as well as skin and sinus flora (*Staphylococcus* and *Streptococcus* species). **HP**

Table 2. Proposed Initial Intravenous Antibiotics for Orbital Cellulitis

Ampicillin[6]
Cefuroxime[10]
Ampicillin and nafcillin[27]
Ampicillin and methacillin[6]
Ampicillin and chloramphenicol[4,20]
Cefazolin and gentamicin[18]
Metronidazole and rocephin[34]
Vancomycin and chloramphenicol[7]
Cloxacillin and chloramphenicol[7]
Imipenem and vancomycin[21]

Data from Gellady et al,[4] Smith et al,[6] Noel et al,[7] Lessner and Stern,[10] Kikkawa et al,[18] Schramm et al,[20] Duarte Reis et al,[21] Goldberg et al,[27] Haufschild.[34]

Test your knowledge and comprehension of this article with the *Clinical Review Quiz* on page 26.

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