Orbital (postseptal) cellulitis is used to describe infectious involvement of the tissues posterior to the orbital septum, including the fat and muscles within the bony orbit. Preseptal cellulitis, in contrast, characterizes a cellulitis of the tissues localized anterior to the orbital septum without involvement of globe and orbit. Both can be caused by external focus of infection (wound), spread of infection from adjacent structures (e.g.: sinusitis) and metastatic infection from elsewhere. These are two distinct clinical entities which share some clinical signs and symptoms. Both are common in children, preseptal cellulitis being far commoner. Orbital cellulitis while less common maybe associated with significant visual and life threatening sequelae, including optic neuropathy, encephalomeningitis, cavernous sinus thrombosis, sepsis and intracranial abscess formation. Medical management focuses primarily on aggressive antibiotic therapy while treating underlying predisposing factors such as sinusitis. Surgical intervention maybe indicated in case of orbital cellulitis with an associated foreign body. In cases of orbital cellulitis with an associated abscess, the precise need and timing of surgery are less clearly defined. Some surgeons have advocated immediate surgical drainage, whereas other surgeons have reported that many of these abscesses resolve with medical therapy alone. The diagnosis of orbital cellulitis still remains challenging even though advances have occurred in imaging technology and antibiotic therapy. Care for these patients is often shared between the pediatrician, ophthalmologist and otolaryngologist.

Aetiology

Preseptal cellulitis follows skin trauma like laceration and insect bite. It may also develop as extension of local infections like acute hordeolum, dacryocystitis and sinusitis. Haematogenous spread from distant foci like upper respiratory tract, middle ear infection are also seen.

Orbital cellulitis most commonly occurs as sinus related infection, ethmoid sinus being most common. Extension from preseptal cellulitis may occur especially in children and in adults following injury to the orbital septum. Local spread from dacryocystitis, mid facial or dental infection is also common. Orbital cellulitis may complicate retinal, lacrimal and orbital surgeries. Haematogenous spread from distant foci is also seen.

Anatomical factors of importance in orbital cellulitis

Orbital septum

Is a fibrous sheath which is attached peripherally around margins of the orbit where it is continuous with the periosteum. Centrally it fuses with the tarsal plates. It effectively separates eyelids from contents of orbital cavity. Importance of this structure is that in children preseptal cellulitis may progress to orbital cellulitis as the septum is not well developed. In adults post traumatic orbital cellulitis is due to injury to orbital septum which helps in spread of infection.

Medial orbital wall

Medial orbital wall is thin and perforated by numerous vessels and nerves. It also has other naturally occurring defects. Thin wall, neurovascular passages and defects help in spread of infection from adjacent sinuses especially ethmoid sinuses.

Subperiosteal space

This space is present between the periorbita and the bony orbital walls. The periorbita has firm attachments to the bone at the orbital sutural lines. In other areas the periorbita is relatively loosely adherent to the bony orbit. Importance is that commonest location of sub periosteal abscess is along medial wall where periorbita is loosely attached to the bony wall.

Venous drainage from middle third of face is via orbital veins. They are valve less and can cause both antrograde and retrograde spread of infection. Inter muscular septa between recti muscles are often thin and deficient posteriorly allowing easy extension of infection between extra conal and intraconal spaces, causing greater chance of optic nerve involvement.
**Epidemiology**

No racial or sexual predilection exists for adults. However in children males are twice as likely to develop orbital cellulitis as compared to females. Median age of children hospitalized with orbital cellulitis is 7 to 12 years. This condition is more common in winter months worldwide because of increased risk of sinusitis. Before routine use of haemophilus type b (Hib) vaccination, the incidence of preseptal and orbital cellulitis due to Hib was reported to be as high as 80%. Since the introduction of Hib vaccination; this has decreased to approximately 59%.

**Microbiology**

Historically, H. influenzae type b was one of the most common organisms associated with the preseptal and orbital cellulitis in children prior to the introduction and widespread adoption of the Hib vaccine in 1985. Recent studies showed staphylococcus species as the commonest organism causing pediatric orbital cellulitis. Methicillin resistant Staph. aureus (MRSA) represented 73% of S. aureus isolates. Streptococcus species was the next common pathogen followed by haemophilus species. The introduction of Hib vaccination seems to have effected not only a decline in Hib related cellulitis but a decline in periorbital cellulitis of any cause. An intriguing hypothesis is that perhaps Hib was not only an active pathogen but also facilitated the pathogenesis of other organisms. Anaerobic bacteria is common in orbital cellulitis following dental infections. Fungal infections like mucormycosis and aspergillosis are associated with immune compromised patients and patients with diabetic ketoacidosis.

**Clinical Features**

Preseptal cellulitis typically presents with eyelid oedema and erythema. The extent of infection is superficial and does not extend posteriorly into the orbit. Visual acuity, pupillary reactions, extra ocular motility and intraocular pressures are normal.

Orbital cellulitis is characterized by rapid onset of erythema and swelling. There will be associated severe pain. Systemic features like fever, headache and malaise will be there. Patient may complain of blurred vision with or without diplopia. On examination there is severe lid edema and erythema. Conjunctiva is usually severely congested with chemosis. Purulent discharge may be present. There will be proptosis (downward and laterally) which maybe obscured by lid swelling. Resistance to retropulsion and painful ophthalmpoplegia will be there. Pupillary reaction may show a relative afferent pupillary defect. Fundus examination may reveal features of optic neuropathy.

**Classification of orbital infections**

Classification of orbital infections by Smith & Spencer and later modified by Chandler in 1970 is the most widely accepted classification.

- Stage 1-preseptal cellulitis
- Stage 2-orbital cellulitis
- Stage 3-subperiosteal abscess
- Stage 4-orbital abscess
- Stage 5-cavernous sinus thrombosis

**Complications**

Preseptal cellulitis usually resolves without serious complications. Unusual complications like lid abscess, lid necrosis maybe seen. Rarely may it progress to orbital cellulitis. Orbital cellulitis can have many complications.

**Ocular**

Ocular complications like exposure keratopathy, raised IOP, central retinal artery and vein obstructions and optic neuropathy can occur. All of these can lead to blindness.

**Subperiosteal abscess**

Located along medial wall of the orbit. Common in sinus related infections. It is a serious complication as it has rapid progression causing increased intra orbital pressure, visual impairment and intracranial extension. Orbital abscess usually occur as a complication of post traumatic and post surgical orbital cellulitis.

**Intra cranial involvement**

Meningitis may be seen in 2% of the patients. Cavernous sinus thrombosis is another serious complication but it is now rare in developed countries and with adequate antibiotic therapy. Consider cavernous sinus thrombosis if there is rapid
progression of signs with increasing proptosis, mydriasis, dilatation of retinal veins, decreased visual activity, afferent pupillary defect and restriction of abduction in other eye. Intradural, epidural and subdural abscess and also rare complications associated with altered consciousness, signs of CNS disturbances and persistent fever despite antibiotic therapy.

**Differential diagnosis**

Other causes of eyelid swelling such as trauma, malignancy (e.g., acute lymphoblastic leukemia and neuroblastoma), thyroid eye disease, orbital inflammatory syndrome and dacryocystitis with inflammatory spillover into the eye lid. Eyelid oedema and chemosis can also occur in renal disease, allergic reactions and infectious conjunctivitis.

Idiopathic orbital inflammatory syndrome is often misdiagnosed as orbital cellulitis. Adults with these conditions however are febrile and lack malaise and associated sinus infection. The acute inflammation that is often present in thyroid eye disease can appear similar to the signs of cellulitis the presence of eyelid retraction and often abnormal thyroid function studies, however, usually indicate the appropriate diagnosis. In children malignancies such as rhabdomyosarcoma, neuroblastoma and advanced retinoblastoma need to be distinguished from orbital cellulitis. Finally unusual orbital inflammation such as tuberculosis, syphilis, and actinomycosis, fungal and parasitic diseases should be considered.

**Management**

**Evaluation of a patient with preseptal or orbital cellulitis**

Both preseptal and orbital cellulitis can present with eyelid inflammation, and distinguishing between the conditions may be challenging. In the evaluation of a patient with preseptal cellulitis however it is critical to assess for the presence of orbital involvement, as orbital cellulitis has the potential for serious complications. A meticulous examination based on the recognition of distinctive signs, relevant history and an understanding of predisposing risk factors is paramount in accurate diagnosis and expeditious treatment.

The extent of ocular involvement can be determined by assessing visual acuity, pupillary reaction, confrontation visual fields, colour vision, extra ocular motility, proptosis, globe displacement, intraocular pressure and ophthalmoscopy to assess for optic nerve oedema and venous tortuosity. The amount of proptosis and degree of extra ocular motility restriction should be measured and documented. Additionally, the examiner should assess for meningeal signs and neurological deficits. After the initial examination the examiner should follow the orbital cellulitis patient with at least daily assessment of visual acuity, colour vision, pupillary reaction and extra ocular motility.

**Investigations**

Routine investigations like total blood count, blood culture which may be helpful in children may be done. Any discharge from skin breaks should be swabbed and sent for microbiology examination. Throat swabs and samples of nasal secretions may also be helpful.

X-Ray PNS will show sinus opacification.

![Figure 3: Axial contrast CT image of a patient with preseptal cellulitis of left eye. Shows diffuse thickening of soft tissues in the preseptal region. Post sepal region is normal.](image)

**CT Scan**

It is the most comprehensive investigation in ocular infections. High resolution CT scan with contrast of sinuses as well as orbit and brain should be taken. Both axial and coronal studies are taken. Advantage of CT scan is that it establishes diagnosis. Site and extent of subperiosteal abscess is clearly demonstrated. Retained intraorbital or ocular foreign body may also be seen clearly. It is also helpful in cases of cavernous sinus thrombosis and peridural and parenchymal brain abscess. CT scans should be repeated if complications occur or when patient is not responding to the treatment given.

**CT findings in orbital cellulitis**

Diffuse soft tissues stranding of orbital fat with thickening of the orbital structures and proptosis is seen. Associated sinusitis and bone erosion may also be seen. Orbital abscess will appear as fluid collections in orbit showing peripheral enhancing rim of varying thickness. Small air pockets may be seen. Subperiosteal abscess appears as hypo dense lesions with peripheral ring enhancement in the extra conal space often with marked proptosis. Air fluid level, if seen, is pathognomonic.
Figure 4: Axial post contrast CT image of a patient with orbital cellulitis of left eye, it shows thickening in the preseptal region (white arrow heads), fluid collection in the extraconal space between medial rectus and lamina papyracea with an air bubble (white dot) findings compatible with an abscess. Ethmoid sinusitis involvement is also seen.

MRI Scan
It is superior to CT scan if cavernous sinus thrombosis is suspected.

Lumbar puncture
It is done when meningeal and cerebral signs develop.

Treatment

Medical Management¹
The primary management strategy in the treatment of preseptal cellulitis focuses on appropriate antibiotic therapy, which should be promptly initiated and modified, based on clinical response and interpretation of gram stain, culture and sensitivity results.

In cases of mild preseptal cellulitis in adults and children older than 1 year of age, treatment is typically rendered on an outpatient basis with empiric broad spectrum oral antibiotics, provided there is reliable access to close follow-up and no evidence of systemic toxicity. Patients who fail to respond or demonstrate clinical worsening should be promptly transitioned to intravenous antibiotics.

Patients who require hospital admission with intravenous antibiotics include children less than 1 year of age, individuals who lack immunization against H influenzae and S pneumonia, immuno suppressed patients and those with evidence of more severe infection.

Antibiotics
Preseptal cellulitis: Initial therapy should be directed against sinusitis pathogens (S. pneumonia, non typable H. influenzae, S. aureus, and moraxella catarrhalis) however in areas where methicillin resistant S.aureus is prevalent, appropriate antibiotics should be added (e.g. clindamycin, trimethoprim, sulphamethozaxole, or doxycycline for oral treatment and vancomycin for inpatient treatment). In cases with dirty wounds, gram negative infections must be considered.

Outpatient treatment is an option for patients in whom orbital cellulitis has been definitely excluded; children should have no signs of systemic infection and should be in the care of responsible parents or guardians. Patients should be closely followed by an ophthalmologist. Outpatient treatment options include amoxicillin/clavulanate 30mg/kg po 8 h (for children < 12 years) or 500mg po tid or 875mg po bid (for adults) for 10 days. For inpatients, ampicillin/sulbactam 50mg/kg IV q 6 h (for children) or 1.5 - 3 mg (for adults) IV q 6 h (maximum 8g ampicillin/day) for 7 days is an option.

Orbital cellulitis: Patients with orbital cellulitis should be hospitalized and treated with meningitis-dose antibiotics. A 2nd- or 3rd- generation cephalosporin, such as cefotaxime 50mg/kg IV q 6 h (for children < 12 years) or 1-2 g IV q 6 h (for adults) for 14 days, is an option when sinusitis is present, imipenem, ceftriaxone and piperacillin/tazobactam are other options. If cellulitis is related to trauma or foreign body, treatment should cover gram positive (vancomycin 1 g IV q 12 h) and gram –negative (eg:ertapenem 100 mg IV once/day) pathogens and last for 7 to 10 days or until clinically improved. Metronidazole (against anaerobes in dental infection) 500 mg 8 hrly IV is also used. Most patients with orbital cellulitis benefit from a nasal decongestant like oral pseudoephedrine or nasal phenylephrine and warm compresses. Local anti glaucoma medications, lubricants and topical antibiotics for corneal protection are also indicated. Steroids may be started for their anti inflammatory action only after 2-3 days of antibiotic therapy and until after any surgery is performed. Surgery to decompress the orbit, drain an abscess, and/or open infected sinuses is indicated in any of the following circumstances:

1. Vision is compromised
2. Suppuration or foreign body is suspected
3. Imaging shows orbital or subperiosteal abscess.
4. The infection does not resolve with antibiotics

Nonsurgical management of subperiosteal abscess of orbit³ - Expectant observation on broad spectrum antibiotics is initiated if all of following surgical criteria were absent

1) Age of patient 9 years or older
2) Presence of frontal sinusitis
3) Non medial location of SPA
4) Large SPA
5) Suspicion of anaerobic subperiosteal infection (e.g.: presence of gas within the abscess space as visualized on CT scan)
6) Recurrence of SPA after previous drainage
7) Evidence of chronic sinusitis (e.g.: nasal polyps)
8) Acute optic nerve or retinal compromise

Visual and pupillary examinations should be performed a minimum of every 6 hours for at least the first 48 hours. Surgical drainage is then indicated for any of four events;
1) Development of visual loss or afferent pupillary defect at any time
2) Absence of defervescence within 36 hours
3) Clinical deterioration after 48 hours
4) Absence of clinical improvement after 72 hours of medical treatment

Surgical drainage of subperiosteal abscess within 24 hours was recommended for patients in whom surgical criteria were present.

Patients were treated with intravenous antibiotics for a minimum of 4 days, followed by a 3 week course of broad spectrum oral antibiotics (usually amoxicillin/clavulanate).

A successful outcome was defined as complete clinical resolution of the orbital subperiosteal abscess, including normal vision, pupillary examination, motility and globe position.

Unlike subperiosteal abscesses, however, orbital abscesses usually require surgical drainage particularly in cases where there is a lack of improvement/progression of disease despite antibiotics, a retained foreign body and concurrent cavernous sinus or intracranial involvement.

There are several other situations that may necessitate prompt surgical intervention. Cases of retained orbital foreign body with associated orbital cellulitis including iatrogenic foreign bodies such as scleral buckles and glaucoma drainage devices require prompt removal of foreign body to facilitate resolution of the infection. Other situations include fulminant infection of an ocular adnexal structure, such as endophthalmitis or dacrocystitis, where surgical de bulking of the infectious source is required in addition to antibiotic therapy. Lastly, in cases of mucormycosis or aspergillosis, treatment often involves extensive surgical debridement in addition to aggressive anti fungal therapy.

**Conclusions**

Orbital cellulitis is not an uncommon condition with the potential for significant visual and life threatening complications. Prompt diagnosis and expeditious treatment are important in minimizing complications and an understanding of anatomic considerations, predisposing factors, microbiology and evolving management strategies is paramount in achieving these goals.

**References**

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