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The Diagnosis and Management of Orbital and Periorbital Cellulitis

Developed by Zachary Rumlow MS-IV and Dr. Peter Gill
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Introduction:

Hello, my name is Zach Rumlow, and I am a fourth-year medical student at Rocky Vista University in Colorado, United States. I would like to thank Dr. Peter Gill of the University of Toronto, Canada for assisting me with the creation of this podcast. I would also like thank Alexandra Moody, a second-year medical student at Rocky Vista University who has provided anatomical illustrations to accompany this podcast. The illustrations can be found in the appendix of this script. Today we are going to discuss the infectious diseases of the orbit, namely, orbital and periorbital cellulitis along with their associated complications

Let's start with a case:

> **You are a fourth-year medical student on the admitting service for the pediatric hospitalist group. You are alerted of a six-year-old male in the emergency department with a two-day history of facial swelling. You enter the patient's room and find them in moderate distress.**

By the end of this podcast, listeners should be able to:

1. Discuss the relevant anatomy that contributes to the presentations of periorbital and orbital cellulitis
2. Describe the basic definitions that differentiate periorbital and orbital cellulitis
3. Discern the most likely etiologies of periorbital and orbital cellulitis
4. Delineate the most common presentations of periorbital and orbital cellulitis and the red flag features of severe disease
5. Describe which therapies are effective in managing periorbital and orbital cellulitis
6. Provide adequate discharge criterion and follow-up plans for patients with periorbital and/or orbital cellulitis

Understanding how to properly diagnose and manage children with orbital and periorbital cellulitis is important due to the potentially serious complications which can arise from inadequate therapy and delayed diagnosis. This podcast is meant to provide a framework of the current understanding and best practices, and to also provide a deeper understanding of the underlying pathology.

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Anatomy

To begin, let us review the relevant anatomy needed to better understand periorbital and orbital cellulitis. The orbit is a conic cavity of the skull formed by the unions of multiple bones, which the eye and its supporting structures sit within.[1,2] Orbital cellulitis is a catchall definition of an infection of the tissue deep to the orbital septum. The orbital septum extends from the periosteum of the frontal bone to the upper and lower eyelids. On the other hand, periorbital cellulitis is an infection of the tissue superficial to the orbital septum.[1,2,3] Periorbital cellulitis and preseptal cellulitis are synonymous and you will find they are used interchangeably.

Due to high rates of concomitant sinusitis with these pathologies, but in particular, orbital cellulitis, the frontal, ethmoidal, sphenoidal, and maxillary sinuses can play a role in the development of these infections. Of particular importance is the ethmoidal sinus, as the periosteum of the overlying ethmoid bone is particularly thin allowing for easier communication of rhinosinusitis of the ethmoidal sinus with the structures of the orbit.[3] Additional structures which occupy the orbit, and can be impacted by infections include, the orbital veins, the retinal artery and vein, and the optic nerve. It is important to note that the orbital veins are valveless and drain directly to the cavernous sinus.[1,2,3] Such drainage allows for direct communication with the intracranial space which can result in intracranial infections.[3,4]

It is worth mentioning that the radiologic criteria used to stratify these diseases known as the Chandler Classification utilizes this anatomy. The first classification defines periorbital cellulitis; the second, orbital cellulitis; the third, orbital cellulitis with the development of an abscess below the periosteum of the ethmoid bone; the fourth, an abscess within the orbit; the fifth, septic thrombophlebitis of the cavernous sinus. We will discuss these diseases processes and terminologies throughout this podcast and beware that they may be used in radiologic reports.[2,5]

History and Physical Exam

Several comorbidities are important in the development of orbital and periorbital cellulitis. It is also important to realize that periorbital cellulitis can lead to orbital cellulitis via direct spread through the orbital septum. Additionally, both orbital and periorbital cellulitis are associated with pathology of the eyelids and face including but not limited to hordeolums, chalazions, dacrocystitis (infection of the lacrimal gland) and impetigo. While both infections are associated with rhinosinusitis, it is only found in approximately one-third of periorbital cellulitis cases compared to nearly all cases of orbital cellulitis. [1,2,4,6] It is important to ask for a history of these infections as patients or parents may not volunteer this information unless asked about recent eyelid infections, styes, or skin infections. Other important risk factors in children are foreign bodies and animal bites.[2] It is worth noting that males are twice as likely to develop orbital cellulitis as females, but the prevalence of periorbital cellulitis is nearly equivalent across the sexes.[1,6]

Physical exam findings of periorbital cellulitis and *early* orbital cellulitis tend to be relatively similar while the presentation of *late* orbital cellulitis is often an entirely separate entity.[1,3,4] Children with periorbital and/or early orbital cellulitis will describe painful swelling of the tissue surrounding the eye that can, but often does not, result in ophthalmoplegia or loss of vision.[1,2,3,6] Infection of the orbital fat pad resulting in proptosis should increase suspicion of orbital cellulitis. Additional warning signs of orbital cellulitis increased pain, ophthalmoplegia, and or changes in vision. In reality, it can be difficult to objectively determine these signs in children with a red, painful, and swollen eye.

One important difference between periorbital orbital cellulitis is the presence of constitutional symptoms such as fever, nausea, lethargy, and a generally unwell appearance in patients with orbital cellulitis; whereas, patients with periorbital cellulitis rarely present with systemic signs of disease.[1,2,3,6] Lastly, children often cannot verbalize their symptoms to either parents or providers. It is important to utilize the entirety of your interaction with patients to look for non-verbal cues, observe the mobility of their eye, and observe signs of increased pain and discomfort with eye movement.

Let's return to our case:

> **You ask the parents more about the current presentation. They state that the swelling around the eye has been present for two days and that their son had "allergies" for about a week prior to this swelling. They also say that their son has recently "felt hot." Review of systems is otherwise negative. He regularly visits a pediatrician who has no concerns about his health. Your patient has a fever of 38.2 ºC, but all other vitals are within normal limits. Physical exam findings include bilaterally erythematous and boggy, and bilateral tenderness to palpation of the maxillary sinuses. Erythema and conjunctivitis of the right eye and eyelid are noted. The right eye is also mildly proptotic. The patient retracts to palpation of the right eyelid. There is no ophthalmoplegia and bilaterally there are no deficits in cranial nerve function. The left eye and its surrounding tissues appear normal**.

Laboratory

On clinical exam alone, it can be difficult to differentiate periorbital and orbital cellulitis; therefore, laboratory and imaging findings are often used to discern a diagnosis. In patients with suspected orbital cellulitis, it is reasonable to obtain a complete blood count, and/or inflammatory markers such as an erythrocyte sedimentation rate, C-reactive protein, and/or procalcitonin.[1,3,4] In patients with orbital cellulitis, it is likely that one or more of these lab tests will be abnormal. Direct cultures of purulent material are not possible without invasive measures and typically reserved for patients requiring surgery. Although obtaining blood cultures may seem important due to the systemic signs of inflammation present in patients with orbital cellulitis, they often provide little diagnostic information and are typically reserved for extremely unwell appearing patients, or if there is suspicion

of an atypical organism, such a fungus or mycobacterium, this can be observed in immunocompromised patients.[1,2,7] We will later discuss indications for imaging.

Let's return to our case:

> **Due to a high clinical suspicion of orbital cellulitis you and your attending proceed with obtaining a CBC which demonstrates a leukocytosis and thrombocytosis. You also obtain a procalcitonin level which is elevated. At this time, blood cultures are not obtained**.

Infectious Etiologies and Antibiotic Therapies

Let us discuss the most common bacterial etiologies of orbital and periorbital cellulitis along with rational antibiotic choices. Most cases of orbital cellulitis, and many cases of periorbital cellulitis, are preceded by sinusitis and therefore have predictable bacterial etiologies making proper antibiotic therapy easier to identify. As always, it is important to consider local antibiograms and prevalence of methicillin resistant *staphylococcus aureus* (MRSA). In the United States, the prevalence of MRSA has been noted to be as high as 75% but is much less common in Canada and the United Kingdom. [1,2,4,6,7]

Infections of the skin, such as hordeolums, chalazions, impetigo and dacryocystitis are usually due to *staphylococcal* and/or Group A *streptococcal* infections and can be treated with first generation cephalosporins and/or anti-*staphylococcal* penicillins such as dicloxacillin, nafcillin or oxacillin.[1,3,4,7] Similarly, uncomplicated periorbital cellulitis can also be managed with a first or second generation cephalosporin. Animal bites are much less common sources of disease and are most commonly associated with *prevotella* growth. Antibiotic therapy in the case of animal bites is typically amoxicillin/clavulanate.

Nearly all cases of orbital cellulitis are associated with bacterial rhinosinusitis, which is commonly due to infection by *haemophilus* species, *streptococcal* species or *moraxella* species.[1,7] With the advent of the type B *Haemophilus influenza* and *Streptococcal pneumoniae* vaccines, the incidence of these infections has reduced. Remember to keep these bacteria in mind in unvaccinated patients.[1,2,7] The most appropriate antibiotics for empiric therapy are third generation cephalosporins, which typically offer adequate coverage. Some providers will also add an anti-*staphylococcal* penicillin (e.g. cloxacillin) to provide coverage of methicillin sensitive *Staphylococcus aureus* or vancomycin if there are risk factors for MRSA. Additional antibiotics are added depending on patient risk factors and clinical preference. In the case of orbital cellulitis which is suspected to be secondary to an oral infection, as is more common in adolescents and those who have recently undergone oral maxillofacial surgeries or invasive dental procedures; antibiotics should cover for mixed aerobic and anaerobic flora. Such regimens include clindamycin, metronidazole, and a third generation cephalosporin.[1,2,3,6] It is worth noting, that in cases of severe orbital cellulitis associated with abscesses, many providers will add anaerobic coverage with metronidazole.

Finally, let's discuss fungal and mycobacterial disease. When considering fungal infections, we are concerned about *aspergillus* and/or *mucormycosis* infections. Such infections are observed primarily in patients with uncontrolled diabetes mellitus and/or severe

immunocompromization. In addition, atypical *mycobacterial* infections can be observed in patients with severe immunodeficiencies.[2,1] All such cases require use of antifungals and/or antimycobacterials along with surgical debridement.[1,2] All affected patients should follow-up with appropriate subspecialists, in particular Infectious Diseases.
Evidence is conflicting on whether adjunctive therapy with oral and intranasal decongestants, antihistamines, mucolytics, and/or corticosteroids are beneficial in children with orbital cellulitis. Given the lack of clear clinical practice guidelines, defer to the appropriate subspecialists whether these additional interventions are indicated.[1,2]

Clinical Management

Now, we must consider the route of antibiotic use and determine if patients are managed on an inpatient or outpatient basis. In general, periorbital cellulitis is treated on an outpatient basis with oral therapy with a first or second generation cephalosporin for 7-10 days.[1,2,3] Exceptions include children under the age of one due to limitations in physical exams and incomplete vaccination schedules, children who are immunocompromised, and/or children who present with features of orbital cellulitis.[1] Patients meeting some or all of these criteria generally require inpatient therapy for up to 48-72 hours with parenteral antibiotics followed by oral outpatient therapy. Children with features of orbital cellulitis require inpatient management due to the higher rates of complications. Assuming an adequate clinical response to parenteral therapy, most patients will be discharged and treated for 10-14 days using enteral antibiotics.[1,2,4,6,7] In general, children that require inpatient care should be seen by colleagues in otolaryngology and/or ophthalmology to determine the extent of involvement.

Let's return to our case:

> **Due to a high clinical suspicion of orbital cellulitis, the boy is admitted to hospital. Given the high local prevalence of methicillin resistant *staphylococcal aureus* you decide to start the patient on IV clindamycin and ceftriaxone. After 72 hours of therapy, pain and swelling have reduced, and repeat CBC and inflammatory markers show improvement. No diagnostic imaging is completed given the response to therapy.**

Surgical Management and Imaging

Historically, surgery had been a mainstay in the treatment of orbital cellulitis; however, as tools to improve detection and appropriate therapies have been developed, the rates of morbidity and mortality have decreased the need for surgical intervention.[2] There are relative indications for surgical management in orbital cellulitis, which are worsening ophthalmoplegia, changes in vision, involvement of the central retinal artery and/or vein, and cavernous sinus thrombosis. Additionally, patients with frontal sinusitis as a predisposing condition are more likely to require surgical intervention when compared to those with ethmoidal, maxillary, or sphenoidal disease. The decision to perform surgery is related to the decision to complete diagnostic imaging. Indications for imaging mirror those

that raise suspicion of the need for surgical management. Although radiation is an unwanted side-effect of CT cans, in most cases, a CT scan with and without contrast remains the first-line imaging modality due to greater image quality of bones and sinuses relative to MRI. At times, an MRI is also completed, but in younger children, it will often require the use of general anesthesia and is thereby limited in use. The use of diagnostic ultrasound has been studied, though studies have not demonstrated sufficient diagnostic adequacy for it to be used in place of either CT or MRI.[8]

Let's return to our case:

Due to improvement in symptoms with antibiotics, no surgery is indicated.

Complications

Providers need to be aware of the potential complications of periorbital and orbital cellulites. The primary complication of periorbital cellulitis is due to direct spread to surrounding tissues. The main complications of orbital cellulitis are endophthalmitis, septic thrombophlebitis, and/or cavernous sinus thrombosis. As thrombosis of the cavernous sinus can affect the third, fourth, fifth and sixth cranial nerves resulting in ophthalmologic deficits, it will cause bilateral symptoms, which differentiates it from the unilateral signs of uncomplicated orbital cellulitis.[1,2,6,7] Since these complications can result in permanent neurovascular disease they warrant further consultation with ophthalmology, otolaryngology and/or neurosurgery. Meningoencephalitis and intracranial abscess are also serious complications, and you should review the meningitis podcast on PedsCases.com for a more in-depth review of these topics. These complications are managed with parenteral antibiotics and often surgical intervention. If surgery is completed, it is helpful to send specimens for aerobic and anaerobic cultures.

Follow-up

Recurrence of periorbital and orbital cellulitis is rare and is often associated with undiagnosed underlying conditions.[9] Recurrent periorbital cellulitis is defined as more than three cases of the disease, each infection spaced by greater than one month, but occurring within the span of one year. Recurrent periorbital cellulitis can be associated with anatomical abnormalities, immunodeficiencies, viral infection (such as herpes simplex), and/or allergic processes. Any case of recurrent periorbital cellulitis requires further workup for appropriate management.[1,9]

Since orbital cellulitis can be associated with loss of vision and intracranial pathology, more thorough follow up is often indicated. As discussed, most patients will be discharged following appropriate intravenous antibiotic therapy; however, follow up with otolaryngology and/or ophthalmology is often required to ensure disease resolution and no visual sequalae.[10]

Let's return to our case:

Your patient was discharged after symptom improvement over 72 hours. They were sent home on oral Amoxicillin/Clavulanate and instructed to return the emergency department if any symptoms returned. They followed-up with their primary care provider after two weeks along with an ophthalmologist to ensure no visual sequalae. They also saw an otolaryngologist in follow-up who recommended oral antihistamines for treatment of chronic allergic sinusitis.

Let's review the key learnings in this PedsCases podcast on periorbital and orbital cellulitis.

In review:

- We discussed the important anatomy of the orbit and the surrounding structures and the roles that they play in the development of orbital and periorbital cellulitis.
- We differentiated the presentations of orbital and periorbital cellulitis from one another and gave special focus to warning signs of orbital cellulitis
- We defined the most likely bacterial etiologies of both diseases and reviewed the most appropriate antibiotic therapies for the diseases
- We reviewed the indications for surgical intervention of these patients along with the criteria for admission
- We briefly discussed the recommended follow-up and potential long-term sequelae and complications of these diseases.

This is the conclusion of our PedsCases podcast. I would again thank to thank Dr. Peter Gill for assisting me with the creation of this podcast and stay tuned for more PedsCases podcasts.

Appendix:

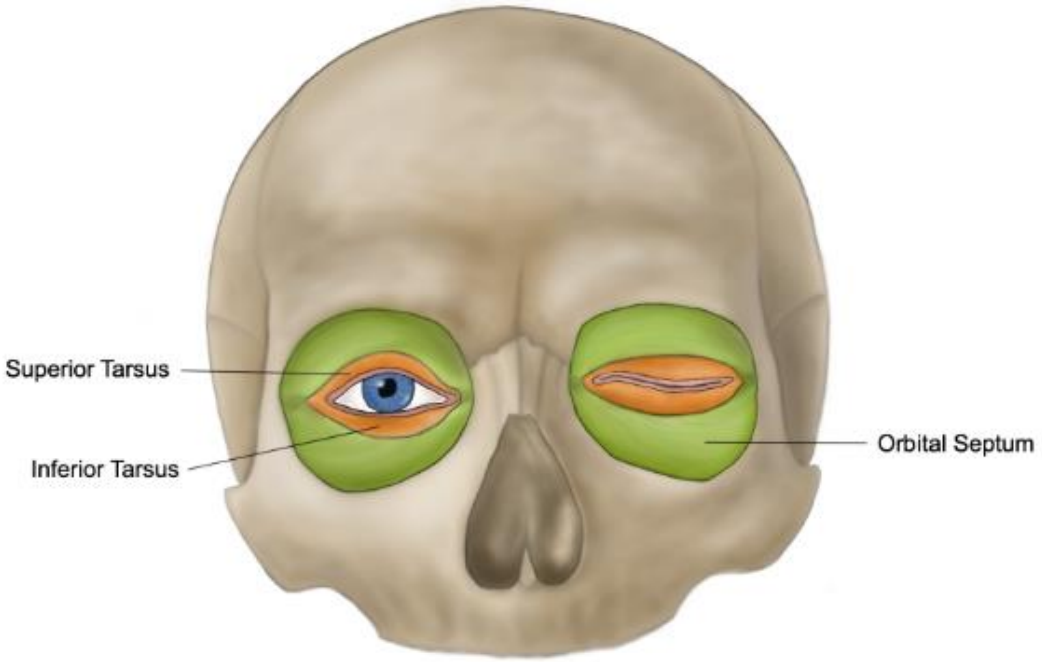

Figure One: An anterior illustration of the Orbital Septum and Superior and Inferior Tarsi of the eyelid

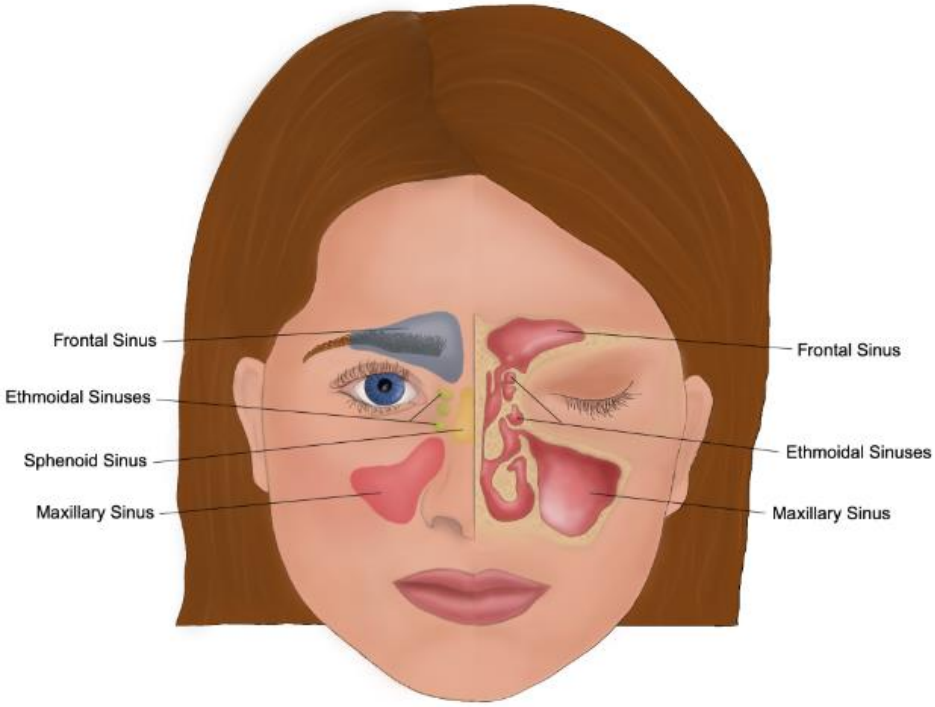

Figure Two: An anterior illustration of the paranasal sinuses

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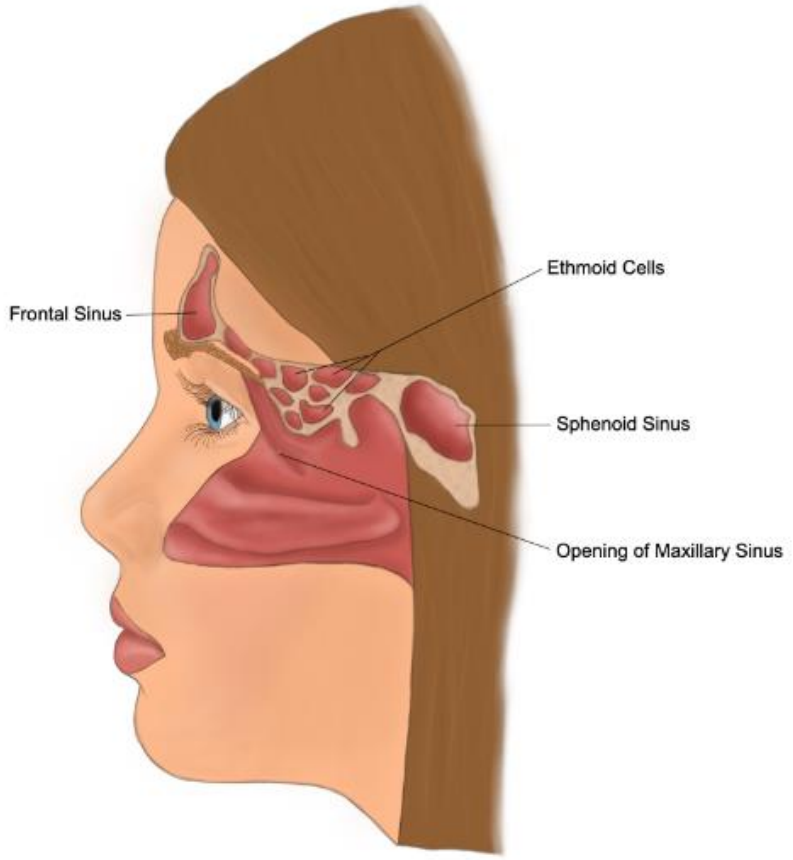

Figure Three: A lateral illustration of the paranasal sinuses

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