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Case Series

Spot the signs, save the sight: pediatric orbital cellulitis from rhinosinusitis

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ABSTRACT

Orbital cellulitis is a potentially devastating condition characterized by acute infection of the orbital contents. While it can occur at any age, it is more prevalent in the pediatric population. Key red flag signs include conjunctival chemosis, proptosis, restricted ocular movements, and reduced visual acuity. Recognizing these signs is crucial for diagnosing post-septal cellulitis, which requires aggressive management involving surgical intervention and parenteral antibiotics to prevent serious complications. This case series presents 8 cases of orbital cellulitis encompassing 3 boys and 5 girls aged 3 to 15 years who were thoroughly assessed, investigated and followed up. Three patients who presented with pre-septal cellulitis were managed conservatively with antibiotics, antihistamines and nasal decongestants while the remaining five who presented with post-septal cellulitis underwent transnasal endoscopic orbital decompression surgery. Post-operative recovery was good. All patients are currently asymptomatic and are under follow-up.

Keywords: Acute rhinosinusitis, Orbital cellulitis, pre-septal cellulitis, post-septal cellulitis, Transnasal endoscopic orbital decompression surgery

INTRODUCTION

Orbital cellulitis is defined as the inflammation of the muscle and fat tissue located within the orbit. The periorbita is thickened at the margins to give attachment to the orbital septum. The orbital septum is a key anatomic landmark used to differentiate pre-septal and post-septal cellulitis.[1] Infections anterior to the orbital septum are consistent with pre-septal cellulitis, while infections of the soft tissue surrounding the eye, posterior to the orbital septum, are referred to as orbital (post-septal) cellulitis.[1] The common causes of orbital cellulitis include secondary infections from the paranasal sinuses, orbital trauma with fractures, ophthalmic foreign bodies, iatrogenic factors such as ophthalmic surgeries, and immunodeficiencies. Acute rhinosinusitis is the most common cause of orbital complications in children, accounting for 60–80% of pediatric cases, with acute ipsilateral ethmoiditis being the most common cause.[1,2] The erosion and destruction of the lamina papyracea, a paper-thin bone separating the ethmoid sinus and orbit provide the most common pathway for the contiguous spread of sinus infection to the orbit.[3] For simplification, Chandler et al, has classified orbital cellulitis into five categories and emphasized the possibility of fatality due to cavernous sinus thrombosis and intracranial abscess.[4]

The most common causative organisms include *Staphylococcus aureus*, *Streptococcus pneumoniae, Streptococcus pyogenes*, and other anaerobes.[5] Whenever orbital complications of sinusitis are suspected contrast enhanced CT should be the initial imaging modality of choice. Additional MRI of the brain is necessary when an orbital or cavernous sinus thrombosis or intracranial extension is suspected.[6]

Orbital cellulitis, if not treated promptly and aggressively can result in vision loss, cavernous sinus thrombosis and even intracranial abscess formation.[7] The trans nasal endoscopic approach provides a potential for more complete disease removal with less impact on eye function and very low rate of complications.[8] This study emphasizes the experiences in diagnosing and managing pre-septal and post-septal cellulitis. It outlines the clinical distinctions between the two conditions, highlighting the importance of accurate diagnosis for effective treatment.

CASE SERIES

This study was carried out from September 2021 to December 2023, at the Department of Otorhinolaryngology, KMC Speciality Hospitals (I) Ltd, Trichy, Tamil Nadu, India. All the procedures were done after obtaining informed consent from all the patients.

Our case series included 8 pediatric patients (3 boys and 5 girls) in the age group 3 to 15 years who were clinically and radiologically diagnosed as orbital cellulitis secondary to acute bacterial rhinosinusitis. Cases presenting with other causes of orbital cellulitis, such as rhino-orbital mucormycosis, nasal vestibular abscess, orbital trauma, and dacryocystitis, were excluded from the study. This exclusion criteria ensured a focused analysis on orbital cellulitis specifically secondary to acute bacterial rhinosinusitis. In our study, no patient had a significant past history or comorbidities.

The patients were thoroughly assessed, investigated and followed up. The data were collected in terms of patients' clinical history, examination, investigation and treatment procedures.

A thorough orbital examination was conducted, emphasizing the presence of red flag signs such as proptosis, chemosis, reduced visual acuity, and ophthalmoplegia during clinical presentation. These signs were closely monitored throughout the follow-up period to ensure timely intervention and optimal patient outcomes.

Diagnostic nasal endoscopy was performed in all patients, confirming the presence of features consistent with acute rhinosinusitis. This assessment played a crucial role in the overall evaluation and management of the patients. All patients underwent routine basic investigations, including complete blood count (CBC), total count (TC), and other inflammatory markers.

Additionally, specific investigations were conducted, such as imaging studies (CT of the paranasal sinuses with orbit and MRI of the brain with orbit) and nasal swabs for pus culture and sensitivity. Antibiotics were initiated empirically at the time of initial presentation and adjusted based on culture and sensitivity reports. Immediate surgical intervention was planned for patients who presented with red flag signs, ensuring timely treatment for those at higher risk of complications.

Statistical analysis was performed using SPSS, (Version 26.0). The continuous variable was expressed as Mean and Standard deviation. Categorical variables were expressed as frequency and percentage. The chi-square test and Fisher's exact test were used to find associations between the categorical variables. $P<0.005$ was considered statistically significant.

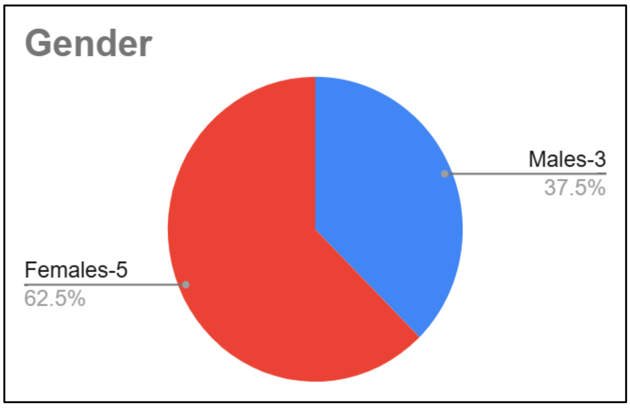

Figure 1: Sex distribution of the patients.

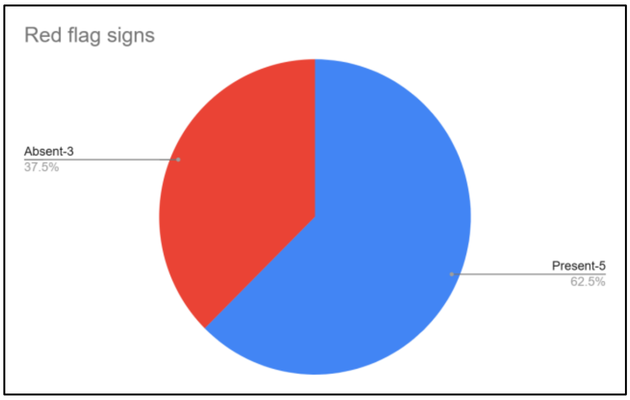

Figure 2: Presence and absence of red flag signs in patients.

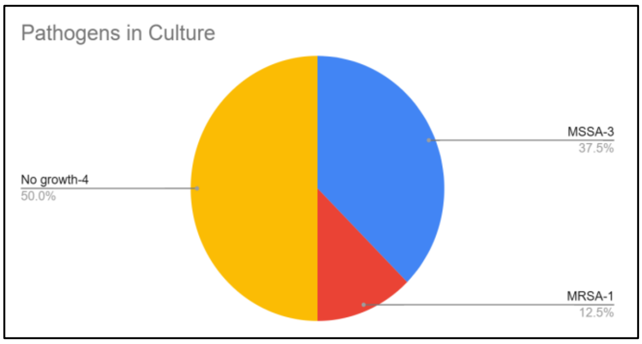

Figure 3: Pathogens in culture and sensitivity.

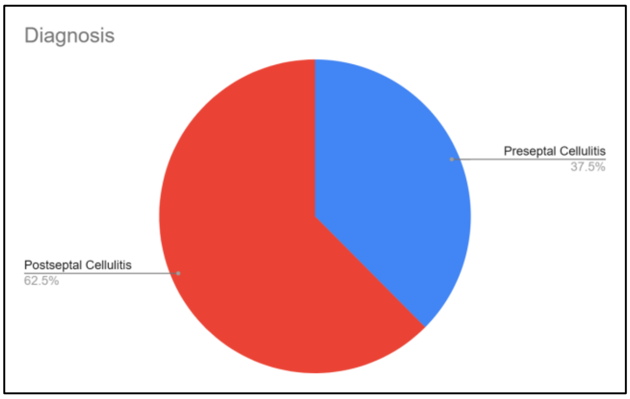

Figure 4: Diagnosis.

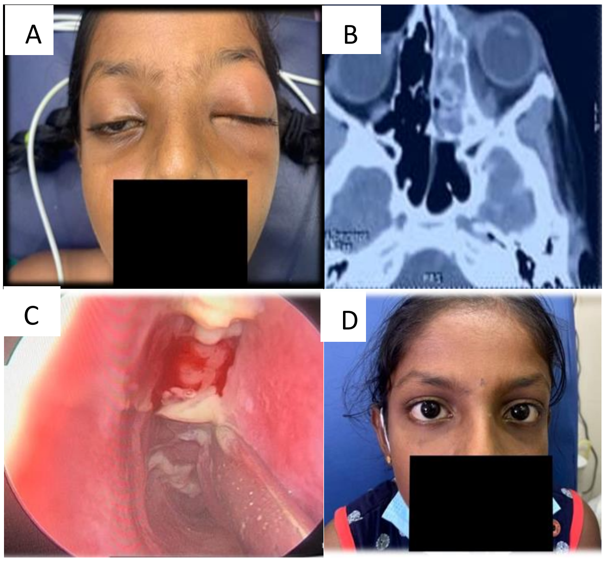

Figure 5: (A) Clinical picture; (B) CT PNS: subperiosteal abscess left eye; (C) transnasal endoscopic orbital & (D) follow up -After 3 weeks decompression (L).

Clinical features: signs and symptoms

In this case series, 5 Patients were girls (62.5%) and 3 were boys (37.5%) (Figure 1). All patients were presented with fever, headache, and upper respiratory infection (URI) symptoms such as nasal obstruction and purulent nasal discharge. Out of the 8 patients, 5 exhibited red flag signs-proptosis, chemosis, ophthalmoplegia, and reduced visual acuity (62.5%)- while the remaining 3 patients presented without red flag signs (37.5%). Table 1 and Figure 2 highlight the presence and absence of red flag signs in patients. This distinction highlights the varying severity of orbital cellulitis in the study. Nasal swab samples were collected for gram stain and pus culture and sensitivity at the time of initial presentation. Empirical antibiotics were started and changed later based on culture and sensitivity reports. The culture and sensitivity reports indicated that 3 out of 8 patients had growth of methicillin-sensitive Staphylococcus aureus (MSSA) (37.5%), and 1 patient had methicillin-resistant *Staphylococcus aureus* (MRSA) (12.5%). The remaining 4 patients' cultures showed no growth (50%). (Figure 3).

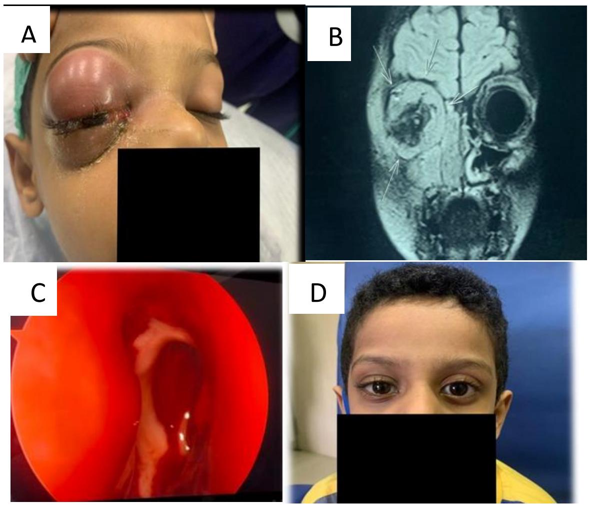

Figure 6: A) Clinical picture; (B) MRI brain- abscess within intraconalmuscle (R) eye C) abscess in the intraconal muscles & (D) follow up-4 weeks drained endoscopically.

Figure 7: (A) Clinical picture & (B) follow up-3 weeks.

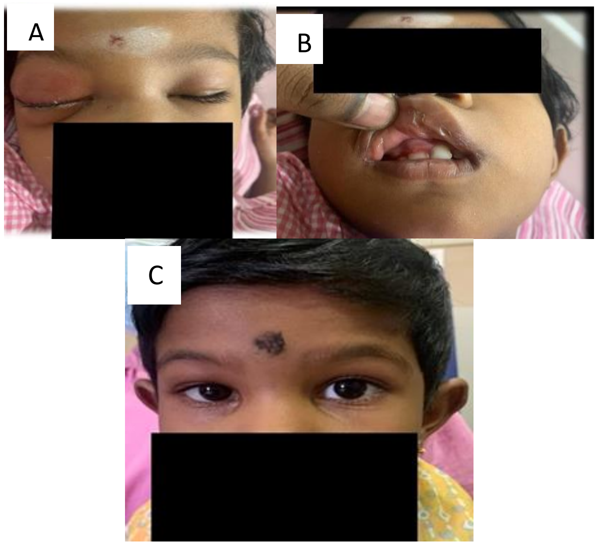

Figure 8: (A) Clinical picture; (B) pus point at (R) gingivobuccal mucosa & (C) follow up- 3 weeks.

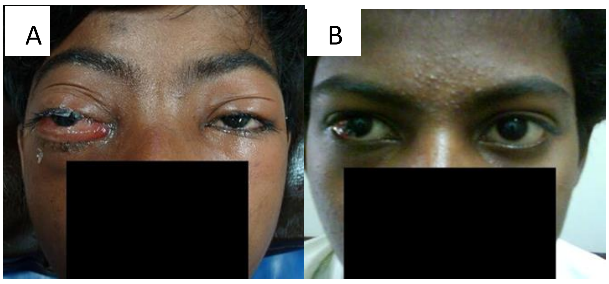

Figure 9: (A) Clinical picture & (B) follow up-4 weeks.

Figure 10: (A) Clinical picture & (B) follow up-2 weeks.

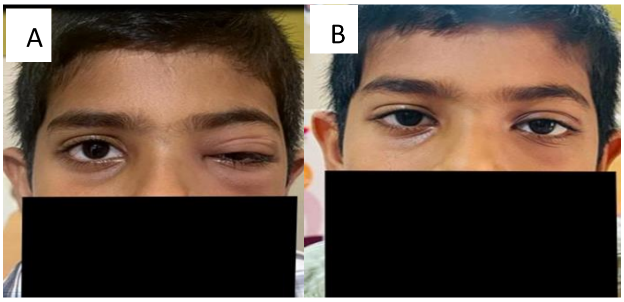

Figure 11: (A) Clinical picture & (B) follow up 2 weeks.

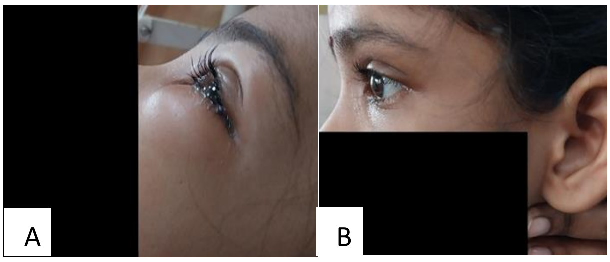

Figure 12: (A) Clinical picture & (B) follow up 2 weeks.

The imaging studies for all cases were thoroughly analysed. A CT scan of the paranasal sinuses (PNS) was performed for all patients, consistently revealing evidence of ethmoidal and maxillary sinusitis.

Additionally, an MRI of the brain with orbital cuts was conducted for five patients due to the severity of their conditions and concerns about potential intracranial extension. Among these, one MRI indicated an abscess deep to the periosteum, while another suggested an abscess within the intraconal muscles.

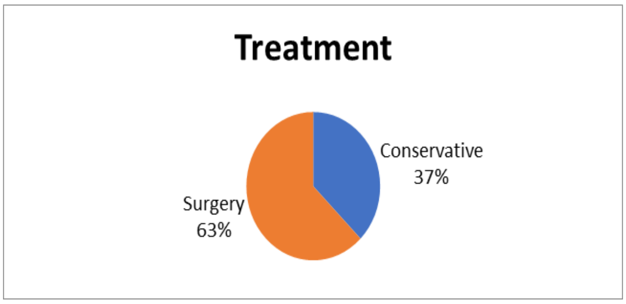

Figure 13: Management-conservative and surgical.

The MRIs of the remaining three patients, who presented with red flag signs, showed inflammation of the orbital tissues in the post-septal compartment. These findings underscore the critical role of imaging in diagnosing and managing orbital cellulitis associated with sinusitis (Table 2).

Diagnosis

In our study, 3 patients (37.5%) presented with preseptal cellulitis, while 5 patients (62.5%) exhibited postseptal cellulitis, which included orbital cellulitis, subperiosteal abscess, and orbital abscess. No patients developed intracranial complications during the course of treatment. The diagnosis is illustrated in Figure 4.

Management

Three patients who presented with pre-septal cellulitis were conservatively managed with antibiotics, nasal decongestants, and antihistamines (37.5%) (Case reports 6-8, Figures 10- 12). In contrast, the remaining five patients with post-septal cellulitis and red flag signs underwent Transnasal endoscopic orbital decompression surgery (62.5%) (Case reports 1 -5, Figures 5- 9). The percentage of patients undergone surgery and Conservative management is highlighted in Figure 13.

In one patient in our study with an orbital abscess (stage 4), the periorbita was incised to facilitate drainage and relieve pressure. Following the incision, the corridor between the medial rectus and superior oblique muscle was explored to ensure complete evacuation of the abscess within the intraconal muscles.

The postoperative period was uneventful, with all patients experiencing minimal oedema, shorter hospital stays, and faster recovery times.

All patients were followed up in the outpatient department one week after discharge and again at one month. Diagnostic nasal endoscopy was performed on all patients, confirming adequate bilateral nasal airflow and no evidence of residual disease in the sinuses.

Proptosis and chemosis had completely resolved, and extraocular movements were full, with no changes in visual acuity. These outcomes indicate a successful management and recovery process for the patients. In our study, patients diagnosed with pre-septal cellulitis were managed conservatively, while those diagnosed with post septal cellulitis exhibiting red flag signs underwent surgical intervention through trans nasal endoscopic orbital decompression.

Table 1: Signs and symptoms: patients with and without red flag signs.

Case no	Age/sex	Fever	URI	Proptosis	Chemosis	Ophthalmoplegia	Gingival abscess	Visual acuity
1	8/F	+	+	+	+	+	-	Reduced
2	5/M	+	+	+	+	+	-	Reduced
3	9/F	+	+	+	+	+	-	Reduced
4	4/F	+	+	+	+	+	+	Reduced
5	15/M	+	+	+	+	+	-	Reduced
6	3/F	+	+	-	-	-	-	06-Jun
7	10/M	+	+	-	-	-	-	06-Jun
8	7/F	+	+	-	-	-	-	06-Jun

Table 2: Diagnosis and management based on radiological findings.

Case no	Age/sex	Sinus involvement on imaging studies				Orbital finding/ staging	Management
		Ethmoidal	**Maxillary**	**Frontal**	**Sphenoid**		
1	8/F	+	+	+	+	Subperiosteal abscess -Stage 3	Surgery
2	5/M	+	+	+	+	Orbital abscess – Stage 4	Surgery
3	9/F	+	+	+	-	Orbital cellulitis – Stage 2	Surgery
4	4/F	+	+	+	-	Orbital cellulitis – Stage 2	Surgery
5	15/M	+	+	-	-	Orbital cellulitis – Stage 2	Surgery
6	3/F	+	+	-	-	Pre-septal cellulitis – Stage 1	Conservative management
7	10/M	+	+	-	-	Pre-septal cellulitis – Stage 1	Conservative management
8	7/F	+	+	-	-	Pre-septal cellulitis – Stage 1	Conservative management

DISCUSSION

The orbital septum is composed of a fibrous membrane attached superiorly to the periosteum along the orbital rim near the *Arcus marginalis* and fuses near the borders of the tarsus. It effectively creates a barrier, preventing the spread of infection from the superficial tissues into deeper orbital spaces. Infection of soft tissues posterior to this orbital septum is referred to as postseptal cellulitis.[9]

In our study girls were more commonly affected than boys. But in similar studies and literature, it is given as 2:1 prevalence in boys compared to girls.[7] Data show that in up to 86% to 98% of cases of orbital cellulitis, there is coexisting rhinosinusitis present.[10] Orbital or intracranial sequelae are the most dangerous complication of recurrent sinusitis. 3.7 to 20% of the patients with sinusitis can present with complications, of which 60-75% will have orbital complications and others will have local and intracranial involvement.[11]

In our study, we focused exclusively on cases presenting with acute rhinosinusitis which was confirmed by Diagnostic Nasal Endoscopy and imaging studies. This allowed for a more targeted analysis of the relationship between acute rhinosinusitis and the development of orbital cellulitis, ensuring a clear understanding of the associated complications. We found that the ethmoid and maxillary sinuses were the most commonly involved in orbital complications associated with sinusitis. This highlights the significant role these sinuses play in the development of orbital cellulitis. Weber et al, reported that 84% of their patients with orbital infections had ethmoid and maxillary sinusitis.[12]

At any age, infection from the neighboring ethmoid sinuses is a likely cause and is thought to result from anatomical characteristics like thin medial wall, lack of lymphatics, orbital foramina, and septic thrombophlebitis of the valveless veins between the two.[9] In our study, it is evident that all patients invariably developed orbital cellulitis secondary to ethmoid sinusitis. This finding underscores the critical connection between ethmoid sinus infection and the subsequent development of orbital complications. Orbital issues arising from acute rhinosinusitis are infrequent but can pose significant risks. Chandler classified orbital complications of sinusitis in devising effective treatment modalities.[13,14] Group 1-Preseptal cellulitis. Group 2-Orbital cellulitis. Group 3-Subperiosteal abscess. Group 4-Orbital abscess. Group 5-Cavernous sinus thrombosis. It is important to be aware of and suspect them to act quickly. Without timely diagnosis and effective treatment, an orbital infection may worsen, extending to adjacent areas and causing severe complications like vision loss, subperiosteal and orbital abscesses, or intracranial spread.

It is essential to define the location and extent of the infection for appropriate management, necessitating a multidisciplinary treatment approach. CT of the paranasal sinuses (PNS) has become the gold standard investigation for patients experiencing complications of acute sinusitis, such as orbital cellulitis.

Additionally, an MRI of the orbit and brain is warranted in cases of severe orbital infection or suspected intracranial extension, providing further clarity on the extent of the disease and guiding treatment decisions. The causative organisms associated with orbital cellulitis can be challenging to identify due to factors such as empirical antibiotic therapy initiated before sample collection and the presence of multiple causative agents. Cultures can be obtained from nasal as well as ocular secretions.

The majority of studies performed in developed countries find *Staphylococcus aureus* and Streptococcus species as the most common causative organisms.[15] Most recent studies from both developed and developing countries underline an increasing trend of orbital cellulitis cases caused by *methicillin-resistant Staphylococcus aureus* (MRSA).[15] The incidence of MRSA in such infections varies from 21% to 72%.[15] In our study, methicillin-sensitive Staphylococcus aureus (MSSA) was the most commonly isolated organism (37.5%) followed by methicillin-resistant *Staphylococcus aureus* (MRSA) (12.5%). These findings highlight the prevalence of Staphylococcus species in cases of orbital cellulitis associated with acute rhinosinusitis.

The management algorithm for orbital cellulitis depends on whether the infection involves the pre-septal or post-septal compartment. This distinction is crucial for determining the appropriate treatment strategy and ensuring optimal patient outcomes. Most patients presenting with pre-septal cellulitis can be managed with oral antibiotics given for 7–10 days, along with anti-inflammatory medications.[9] In our study conservative management was successful in 3 children who were presented with rhinosinusitis and pre-septal cellulitis (37.5%). Antibiotic therapy was initiated empirically, taking into account the expected organisms and the presence of any comorbidities. The antibiotics used were injection ceftriaxone, clindamycin and vancomycin.

Close monitoring was conducted for any signs of progression in the patients' condition. If clinical findings or CT scans show no improvement within 24 to 48 hours, surgical drainage is usually indicated. Severe proptosis, worsening visual acuity, elevated intraocular pressure, colour indiscrimination, intracranial involvement, inability to perform a reliable serial ophthalmologic examination, and poor response to a trial of intravenous antibiotics for 24 to 48 hours are all common indications for surgery.[16] In our study, a significant proportion of patients who presented with red flag signs were diagnosed with post-septal cellulitis and required transnasal endoscopic orbital decompression surgery (62.5%). This association was statistically significant (p value<0.005) as determined by the Chi-square test.

In the trans nasal endoscopic approach; uncinectomy, wide middle meatal antrostomy (MMA), anterior and posterior ethmoidectomy, frontal sinusotomy and sphenoidotomy were done. Diseased mucosa and purulent discharge let out. The lamina papyracea was skeletonized, made disease-free, and subsequently removed. Periorbita visualized and delineated.

Additionally, during the management of the orbital abscess, the pus was drained endoscopically through the medial orbital wall by incising the periorbita, creating a corridor between the medial rectus and superior oblique muscle to ensure complete evacuation of the abscess within the intraconal muscles. This approach facilitates access to the medial orbital wall without requiring an external cutaneous incision. An incision of the periorbita is necessary to drain an orbital abscess, as this provides direct access to the abscess cavity. However, for subperiosteal abscesses, drainage can often be accomplished endoscopically without the need for a periorbital incision.

Notably, no patients developed intracranial complications during the course of treatment. This finding highlights the effectiveness of our management approach in preventing severe complications associated with these conditions. It is mentioned in some of the literature that pre-septal and post-septal cellulitis can generally be managed non-surgically, while orbital abscess and cavernous sinus thrombosis are managed surgically.[17]

The transnasal endoscopic route offers significant advantages over traditional external approaches but may have some limitations in an acutely inflamed and bloody surgical field[18]. Endoscopic intervention allows for reinstatement of the drainage pathways, decompression and washout of pus from the sinuses. The external approach involves the use of a Lynch-Howarth incision for an external ethmoidectomy and drainage of the abscess.[19]

The endoscopic approach demonstrated no postoperative sequelae, highlighting its advantages in minimizing complications. In contrast, external ethmoidectomy was associated with several issues, including facial scarring, delayed healing, stitch abscesses, unresolved diplopia, and recurrent cellulitis.[20]

These complications underscore the benefits of the endoscopic technique in managing medial subperiosteal and orbital abscesses effectively and with fewer adverse outcomes. The success and safety of the surgical procedure depend on skilled endoscopic handling, proper instruments, precise techniques, and careful tissue management. These factors help minimize complications and ensure optimal outcomes for patients undergoing procedures for orbital cellulitis.

The small number of cases may reflect differing treatment approaches (e.g., choice of antibiotics, surgical intervention, duration of therapy), which could lead to inconsistent outcomes without a standardized protocol. In some cases, culture and sensitivity reports were negative, leading to uncertainty in identifying the causative pathogen. This limits conclusions about the bacterial or fungal aetiology of orbital cellulitis in the study.

The absence of a control group (such as children with periorbital cellulitis or milder forms of orbital cellulitis treated on an outpatient basis) makes it challenging to compare outcomes, treatment efficacy, or the natural course of the disease. Future studies with larger, prospective cohorts and standardized protocols would be needed to draw more definitive conclusions about the epidemiology, management, and outcomes of pediatric orbital cellulitis.

CONCLUSION

Meticulous clinical examination and prompt diagnosis are necessary for the management of orbital complications of acute rhinosinusitis. The management guidelines and strategies depend upon the severity of the disease. The presence or absence of red flag signs is an important decisive factor for timely interventions.

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