Orbital and Preseptal Cellulitis: Epidemiology, Etiology, and Management

Dariush Hasheminia [a], **Navid Naghdi** [b *], **Sobhan Pourarz** [c]

[a] Department of Oral and Maxillofacial Surgery, Dental Implant Research Center, Isfahan University of Medical Sciences, Isfahan, Iran; [b] Department of Oral and Maxillofacial Surgery, Dental Implant Research Center, Hamadan University of Medical Sciences, Hamadan, Iran; [c] Department of Oral and Maxillofacial Surgery, Isfahan University of Medical Sciences, Isfahan, Iran.

Corresponding author: Navid Naghdi. Department of Oral and Maxillofacial Surgery, Dental Implant Research Center, Hamadan University of Medical Sciences, Hamadan, Iran. ***E-mail:*** dr.naghdi@umsha.ac.ir; ***Tel***: +98-913 1292950

Submitted: 2019-09-22; **Accepted:** 2019-12-09; **Published Online:** 2019-12-23; **DOI:** *10.22037/rrr.v4i1.26606*

Introduction: Considering the little evidence regarding peri-orbital infections, this study was aimed to obtain information about the epidemiology, etiology, and management of orbital infections. **Material and Methods:** In this retrospective investigation, all patients with peri-orbital infection who were hospitalized in a tertiary ophthalmologic center in AL-Zahra hospital, Isfahan, Iran from 2008 up to 2018 were identified. Documented data and radiographic images were extracted. The data regarding epidemiology, etiology and disease course was analyzed. **Results:** Sixty nine patients (35 males, 34 females) with the age range between 3 months to 85 years were included. Preseptal cellulitis was recorded in 53 cases (76.8%) and orbital cellulitis was seen in 16 cases (23.2%), and the proportion of preseptal to orbital was 3.3 to 1. The mean duration of hospitalization in patients with preseptal cellulitis was 6.38 ±, 4.59 days and in patients with orbital cellulitis was 12.44 ±, 9.63 days. Most patients with preseptal cellulitis were treated by medication therapy (71.7%), while the orbital cellulitis were often treated by surgical procedures (56.2%). Sinusitis was the main cause of both preseptal and orbital cellulitis in all age groups, except infants under 1 year, which dacryocystitis was identified as primary factor. **Conclusions:** The prevalence of peri-orbital infection was higher in children. The prevalence ratio of preseptal to orbital cellulitis was 3.3:1. The main etiologic factor was sinusitis. There is no agreement for the treatment modalities of peri-orbital infections and the timing of surgical intervention. Continuous evaluation of treatment course, both clinically and radiographically is important. Reassessment is recommended when improvement is not seen after 6-7 days of treatment.

Keywords: Orbital Abscess; Orbital Cellulitis; Preseptal Cellulitis; Sinusitis

Introduction

Orbital infections are uncommon inflammatory conditions affecting surrounding tissues of the eyes and generally consists of either preseptal cellulitis which is the infectious inflammation of the soft tissue in front of the orbital septum , or orbital cellulitis which is infectious inflammation of the periorbital tissues beyond the septum of eyelid (1, 2). Among them, the first one is more common (3). The disease is usually caused by sinusitis and occurs more in children and young adults (3). Ethmoid sinus infection often spread to orbital area along lamina papyreacea (4).

Main clinical signs of periorbital cellulitis include limited ocular motility and proptosis (5). Careful diagnosis and treatment planning is mandatory, since in advanced cases the disease can be dangerous and severe complications such as blindness, meningitis, cavernous sinus thrombosis, and even death are possible (6-8). However, effective treatment can decrease the complications. Considering the low prevalence of these infectious diseases, there is not sufficient knowledge about the epidemiology, etiology, course and management of the disease in all geographic areas. Hence, the aim of this retrospective study was to obtain information on the epidemiology, etiology and management of orbital infections.

Materials and Methods

This study was conducted in AL-Zahra hospital, Isfahan, Iran. After achieving the ethical approval from the research board of Isfahan University of Medical Sciences, the medical documents were investigated retrospectively. The study protocol was designed in accordance with Helsinki Declaration. All patients with peri-orbital or orbital cellulitis who were hospitalized in a tertiary ophthalmologic center, during the past 10 years (2008-2018) were identified. Inclusion criteria were as followed: All patients hospitalized with the diagnosis of peri-orbital cellulitis having peri-orbital and orbital swelling and systemic signs of infection, such as fever and malaise. Exclusion criterion was lack of complete document records, including incomplete clinical examination charting and lack of radiography.

Table 1. Summary of study variables

Study variables	Descriptive statistics
Sample size	69
Sex: Male	35 (50.7%)
Age range	3 months to 85 years
Mean age	16.81±21.94
Male	13.6±19.24
Female	20.1±24.26
Cellulitis type	
Orbital	16 (23.2%)
Preseptal	53 (76.8%)
Orbital to preseptal ratio	1 to 3.3

Table 2. Comparison of cellulitis types in patients under 9 years and over 9 years

Age	Cellulitis type N (%)			Treatment type N (%)	
	Preseptal	**Orbital**	**Orbital/Preseptal**	**Medical**	**Surgical**
0-9	33 (76.7%)	10 (23.3%)	1/3.3	32 (74.4%)	**11 (25.6%)**
9<	20 (76.9%)	6 (23.1%)	1/3.3	13 (50%)	**13 (50%)**

The following data were extracted from patients' records: demographic data including age and sex; patient's medical history such as systemic disease and consumed drugs; history of present disease, previous sinusitis, ocular trauma, insect bite, skin ulcer or infection, tooth infection and abscess, drugs which were consumed before hospitalization, and past cellulitis history. The involved side, signs and symptoms including inflammation and erythema, pain, tearing, suppuration, fever, coughing, headache, nausea and vomiting, proptosis, limitation of ocular movements, reduced vision accuracy and diplopia were documented. In addition, radiographic images including CT scan and simple radiography were extracted from archives and hospital electronic records. Type of developed cellulitis (orbital or preseptal) was determined based on clinical signs and radiographic examinations. If clinical signs like limitation in extra ocular muscles movement, proptosis, chemosis, reduced vision accuracy and radiographic signs (inter-orbital inflammation or abscess) for the orbital cellulitis were confirmed, the patient was considered as orbital cellulitis; otherwise, the patient was categorized as preseptal cellulitis.

Para-clinical studies including complete blood count (CBC), bacterial culturing and antibiogram tests, consultations, therapeutic interventions, prescribed antibiotics, hospitalization duration and post treatment complications were recorded.

The obtained data were analyzed by SPSS 22 Software. Paired t-test, chi square ،Fisher's exact test were used as descriptive analyses. *P*-value under 0.05 was considered as statistically significant.

Results

After a comprehensive investigation of medical documents, 72 patients were identified. Three of them were excluded because of missing documents. Thus 69 patients including 35 males (50.7%) and 34 females (49.3%) were included (Table 1). The patients' age ranged from 3 months to 85 years. The mean age of patients was 16.8 years i.e. 13.6 ± 19.24 years old for males and 20.1±24.26 years old for females. Around a quarter of the patients i.e., 16 patients or 23.2%, were one year or less, and two-thirds of the patients *i.e*, 45 patients or 65.2%, were less than 10 years old (Figure. 1).

The orbital to pre-septal ratio in children less than 9 years and patients over 9 years was identical and equal to 1 to 3.3 (Table 2). However, 74.4% of children less than 9 years old were treated by medical therapy, while just 50% of patients over 9 years old were treated by medication, and other patients were treated under surgical intervention. This difference was statistically significant (*P*=0.03).

Symptoms

The most common symptoms which observed in all patients were swelling and erythema. Other common symptoms were pain and high fever. Extra ocular muscle restriction and proptosis were seen only in patients with a diagnosis of orbital cellulitis (Figure. 2).

Type of cellulitis

Preseptal cellulitis was recorded in 53 cases (76.8%) and orbital cellulitis was seen in 16 cases (23.2%). As shown in Table 3,

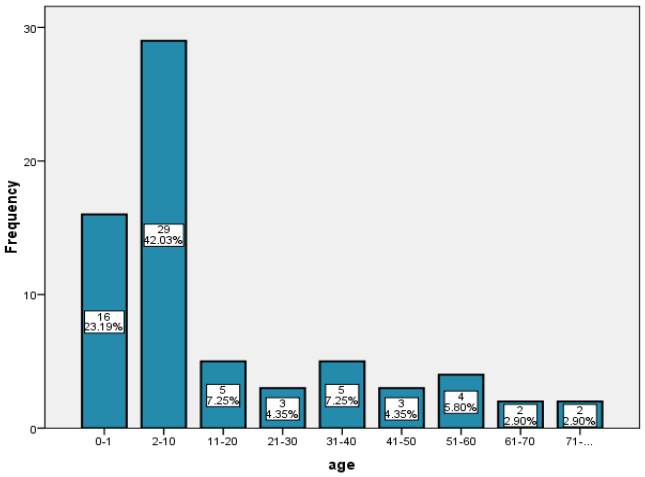

Figure 1. The age distribution of patient

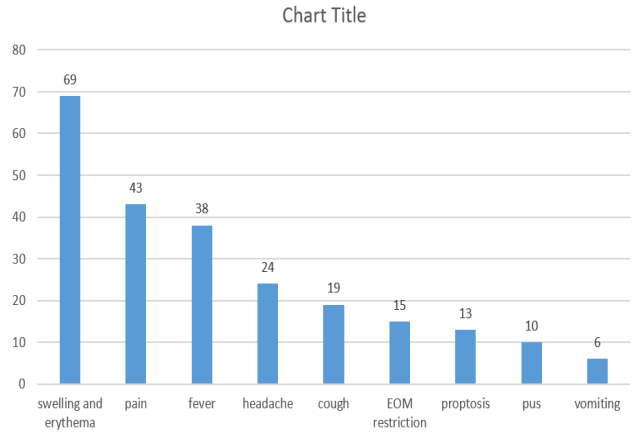

Figure 2. The most common signs and symptoms among the patients. Swelling and erythema were observed in all of 69 patients. (EOM: extraocular muscle movements)

the mean ages between the two groups are not significantly different (*P*=0.54). The mean duration of hospitalization in patients with preseptal cellulitis was 6.38±4.59 days and in patients with orbital cellulitis was 12.44±9.63 days. According to the t-test, the difference was statistically significant (*P*=0.001).

Most patients with preseptal cellulitis were treated by medication therapy (71.7%), while the orbital cellulitis were often treated by surgical procedures (56.2%). According to chi-square, the difference was significant (*P*=0.041).

Treatment

In 45 cases (65.2%), medical treatment and in 24 cases (34.8%) surgical treatment was used. The mean duration of hospitalization in patients with medical therapy was 6.50±4.89 and in patients underwent surgical treatment was 9.88±6.49 days. Based on the t-test, the difference was significant (*P*=0.046).

The mean duration of bedridden for all patients was 7.81±6.59 days. Comparing the duration of hospitalization between the two groups (Table 4) shows that pre-septal cellulitis is usually (67.9%) treated within a week, but orbital cellulitis often (68.8%) require more than 7 days hospitalization. According to chi square, the difference was significant (*P*=0.01).

Etiology

The main cause of disease was sinusitis. Generally, cellulitis arising from all etiologies were often treated by medical treatments. The exception is cellulitis caused by dental infection which is mostly treated through surgical interventions (Table 5).

Orbital cellulitis was caused by sinusitis in 87.5% (14 out of 16). One case was caused by dental infection, and in one case skin infection was the reason. Pre-septal cellulitis was caused by sinusitis in 62.3% of cases (33 out of 53). In 17% of the cases (9 cases) dacryocystitis was the agent, 9.4% (5 cases) were caused by dental infection, 7.5% (4 cases) by trauma, and 3.8% (2 cases) through skin infection.

Dacryocystitis was identified as an agent of cellulitis just in infants under 1 year, and in all cases, pre-septal cellulitis was present. Only in infants under 1 year, sinusitis is not considered as principle etiology factor. In other age categories, the most common cause was sinusitis. (By Fisher's Exact Test, *P*<0.0001).

Among all patients with sinusitis as the reason of disease, the prevalence of sinusitis and the duration of bedridden were as shown in table 7. The following table shows that pansinusitis were more likely to cause orbital cellulitis (Fisher's Exact Test is significant *P*=0.042). In addition, the cellulites caused by pansinusitis were often treated by surgery, while the other types were mostly treated through medication (*P*=0.037).

Discussion

Periocular infections are a variety of bacterial infections and include less severe conditions such as preseptal cellulitis to severe infections such as orbital cellulitis and subperiosteal abscess (9). If periorbital infections left untreated, they may lead to severe complications, such as blindness, cavernous sinus thrombosis, meningitis, intracranial infections, and even death (10).

As other studies have shown, the proportion of preseptal cellulitis is more than orbitals (11). In present study, this ratio was 3.3 to 1. Considering the fact that the large number of

Table 3. Comparison between two categories of cellulitis: preseptal vs orbital

Cellulitis type	Frequency N (%)	Age (mean±SD)	Bedding time (mean±SD)	Treatment N (%)	
				Medical	Surgical
Preseptal	53 (76.8%)	15.92±21.32	6.38±4.59	38 (71.7%)	15 (28.3%)
Orbital	16 (23.2%)	19.75±24.40	12.44±9.63	7 (43.8%)	9 (56.2%)
Total	69	16.81±21.94	7.81±6.59	45 (65.2%)	24 (34.8%)

Table 4. Comparison of preseptal and orbital cellulitis based on 1 week hospitalization period

Cellulitis type	Bedding time (days)	
	0-7	7<
Preseptal N (%)	36 (67.9%)	17 (32.1%)
Orbital N (%)	5 (31.2%)	11 (68.8%)

patients with mild preseptal infections are treated on an outpatient basis and are not registered, in reality, the ratio of preseptal to orbital cellulitis is more than this amount.

The debate in the treatment of preiocular infections is the necessity of surgical intervention, as well as, determining the timing of procedure.Several efforts have been done to design an algorithm for diagnosis, prognosis and treatment planning of periocular infections(12-14). Some indications of surgical intervention in literatures include:

1. Age more than 9 years (15)
2. Large abscess in CT-scan (larger than 1 cm) (9, 10, 15)
3. High fever (10)
4. No response to medical treatment (within 48 h) (3, 9, 10, 15)
5. Signs of intracranial involvement (15, 16)
6. Reduced visual acuity (3, 9, 15, 16)
7. Deterioration of ocular movements (ophthalmoplegia) (13, 16)
8. Proptosis more than 2 mm (15)
9. Gas in orbit (15)
10. Infection of dental origin (15)

In a study regarding the treatment of sinusitis related periorbital infections, Chadha regards the failure of medication therapy and reduced visual accuracy as the *main criteria* for surgical intervention. Based on the study, age over 9 years, diplopia, and proptosis more than 2 mm are some other parameters leading to surgery (17).

In present study, the ratio of orbital to preseptal cellulitis in children under 9 years was equal to the ratio of patients over the age 9 (1 to 3.3); Three-quarters of the patients less than 9 years were treated through medication and only a quarter of the cases required surgical intervention. While 50% of the patients over 9 years were treated surgically. Therefore, treatment in patients over 9 years was significantly more difficult than those who were under 9 years and the response to medical treatment was weaker in people over 9 years. Meshi and Nemet explained that the size of paranasal sinuses is small before the age 9. Enlarging the paranasal sinuseswhile ostium is constant in older ages may associated with more severe sinusitis and poor outcomes subsequent to medical treatment (18).

According to the results of current investigation, in all age groups except infants under 1 year, sinusitis is the most important factor for periorbital infections. Dacryocystitis which is only seen in infants less than1 year is regarded as the main cause of periorbital infections in this age category. All of the cases caused by dacryocystitis were preseptal cellulitis.

The results show that periorbital cellulitis due to sinusitis, trauma, skin infections and dacryocystitis is often treated by medical therapy, while two-thirds of the cases caused by dental infections required surgical intervention. This issue supports Baring and colleagues' idea about the indications of surgical treatment. According to their opinion, periorbital cellulitis caused by dental infection is one of the indications which requires surgical intervention (15).

In the present study, sinusitis was considered as the main cause of periorbital cellulitis. Based on the results obtained, simultaneous involvement of ethmoid and maxillary sinuses was observed in half of patients with sinusitis. Isolated ethmoid or maxillary sinusitis occurred less frequent. Frontal or sphenoid sinus involvement was not seen in any patients except in combined or pan-sinusitis cases. It seems that by multiple involvement of sinuses, treatment becomes more convoluted. In isolated or simultaneous ethmoid and maxillary sinusitis, most patients have responded well to medical treatment and a smaller number of patients required surgical treatment, while 70% of patients with multiple sinuses involvement (pansinusitis) have been treated surgically. The mean duration of hospitalization in patients with pansinusitis is significantly more than patients with mild sinusitis. Chaudhry and colleagues in a study with 218 cases found that pansinusitis compared with isolated sinusitis are more likely to cause orbital cellulitis (3). Therefore, it can be concluded that the treatment of periorbital infections caused by pansinusitis is far more difficult and it is more likely to require surgical intervention.

Table 5. The frequency of etiologic factors and treatment modalities

Cause of infection	Frequency N (%)	Treatment N (%)	
		Medical	Surgical
Sinusitis	47 (68.1%)	29 (61.7%)	18 (38.3%)
Trauma	4 (5.8%)	3 (75%)	1 (25%)
Skin infection	3 (4.3%)	3 (100%)	0 (0%)
Dacryocystitis	9 (13%)	8 (88.9%)	1 (11.1%)
Dental infection	6 (8.7%)	2 (33.3%)	4 (66.7%)
Total	69 (100%)	45 (65.2%)	24 (34.8%)

Table 6. The distribution of etiology factors in different age categories

Cause N (%)	Age			
	0-1	2-10	11-18	19≤
Sinusitis	7 (43.8%)	25 (86.2%)	3 (60%)	12 (63.2%)
Trauma	-	2 (6.9%)	-	2 (10.5%)
Skin infection	-	1 (3.4%)	-	2 (10.5%)
Dacryocystitis	9 (56.2%)	-	-	-
Dental infection	-	1 (3.4%)	2 (40%)	3 (15.8%)
Total	16	29	5	19

Table 7. Comparison between different types of sinusitis

Sinusitis type	Frequency N (%)	Bedding time (Mean±SD)	Convert to orbital cellulitis N (%)	Treatment	
				Medical N (%)	Surgical N (%)
Ethmoid	9 (19.2%)	5.25±2.91	2 (22.2%)	8 (88.9%)	1 (11.1%)
Maxilla	5 (10.6 %)	6.20±8.41	1 (20%)	3 (60%)	2 (40%)
Ethmoid & maxilla	23 (48.9%)	9.09±7.34	6 (26.1%)	15 (65.2%)	8 (34.8%)
Pan-sinusitis	10 (21.3%)	12.60±8.68	5 (50%)	3 (30%)	7 (70%)
Total	47 (100%)			45 (65.2%)	24 (34.8%)

The results of Rayan *et al.* investigation show that patients who underwent surgery had a longer period of hospitalization compared to medical treated cases (10.2 vs. 6.6 days, $P<0.001$) (9). The results of current study confirmed the issue. The mean duration of hospitalization in patients with medical therapy was 6.50±4.89 days, while in patients who underwent surgical treatment was 9.88±6.49 days and the difference was statistically significant.

In addition, the results showed that most cases with preseptal cellulitis (more than two-thirds of cases) were treated within one week of hospitalization, while more than two thirds of patients with orbital cellulitis required more than one week treatment in the hospital. The authors recommend that if after one week of admission, despite appropriate treatment, the patient's symptoms did not improve significantly, reassessment should be done to diagnose the problem (especially in patients with pre-septal cellulitis). In such cases, an incorrect initial diagnosis, inadequate treatment, choice of inappropriate antibiotics or unknown underlying diseases may be involved.

Small number of patients and incomplete documentation was the main limitation of the study. In addition, variety of departments are involved in the treatment of the condition and this led to heterogenous documentation, diagnosis and medical intervention.

Conclusion

The prevalence of peri-orbital infection was higher in children. The prevalence ratio of preseptal to orbital cellulitis was 3.3:1. The main etiologic factor was sinusitis; however, in infants

under 1-year-old the main etiologic factor was dacryocystitis. Children were mainly treated medically, while surgical treatment was more frequent in adults and adolescents.

Because of progressive course of peri-orbital infections, early diagnosis and treatment planning is important. Clinical and radiographic evaluations are required for determination of type and extension of infection. Reassessment is mandatory when improvement is not seen after 6-7 days of treatment.

Conflict of Interest: 'None declared'.

References

1. Wald ER. Periorbital and orbital infections. Infectious disease clinics of North America. 2007;21(2):393-408.
2. Watts P. Preseptal and orbital cellulitis in children. Paediatrics and Child Health. 2016;26(1):1-8.
3. Chaudhry IA, Shamsi FA, Elzaridi E, Al-Rashed W, Al-Amri A, Al-Anezi F, *et al.* Outcome of treated orbital cellulitis in a tertiary eye care center in the middle East. Ophthalmology. 2007;114(2):345-54.
4. Howe L, Jones N. Guidelines for the management of periorbital cellulitis/abscess. Clinical Otolaryngology & Allied Sciences. 2004;29(6):725-8.
5. Weiss A, Friendly D, Eglin K, Chang M, Gold B. Bacterial periorbital and orbital cellulitis in childhood. Elsevier; 1983.
6. Davis J, Stearns M. Orbital complications of sinusitis: avoid delays in diagnosis. Postgraduate medical journal. 1994;70(820):108-10.
7. Swift A, Charlton G. Sinusitis and the acute orbit in children. The Journal of Laryngology & Otology. 1990;104(3):213-6.
8. Wagenmann M, Naclerio RM. Complications of sinusitis. Journal of allergy and clinical immunology. 1992;90(3):552-4.
9. Ryan JT, Preciado DA, Bauman N, Pena M, Bose S, Zalzal GH, *et al.* Management of pediatric orbital cellulitis in patients with radiographic findings of subperiosteal abscess. Otolaryngology-Head and Neck Surgery. 2009;140(6):907-11.
10. Fanella S, Singer A, Embree J. Presentation and management of pediatric orbital cellulitis. Canadian Journal of Infectious Diseases and Medical Microbiology. 2011;22(3):97-100.
11. Bagheri A, Tavakoli M, Aletaha M, Salour H, Ghaderpanah M. Orbital and preseptal cellulitis: a 10-year survey of hospitalized patients in a tertiary eye hospital in Iran. International ophthalmology. 2012;32(4):361-7.
12. Bedwell J, Bauman NM. Management of pediatric orbital cellulitis and abscess. Current opinion in otolaryngology & head and neck surgery. 2011;19(6):467-73.
13. Buchanan MA, Muen W, Heinz P. Management of periorbital and orbital cellulitis. Paediatrics and child health. 2012;22(2):72-7.
14. Smith JM, Bratton EM, DeWitt P, Davies BW, Hink EM, Durairaj VD. Predicting the need for surgical intervention in pediatric orbital cellulitis. American journal of ophthalmology. 2014;158(2):387-94. e1.
15. Baring D, Hilmi O. An evidence based review of periorbital cellulitis. Clinical Otolaryngology. 2011;36(1):57.
16. Souliere Jr CR, Antoine GA, Martin MP, Blumberg AI, Isaacson G. Selective non-surgical management of subperiosteal abscess of the orbit: computerized tomography and clinical course as indication for surgical drainage. International journal of pediatric otorhinolaryngology. 1990;19(2):109-19.
17. Chadha NK. An evidence-based staging system for orbital infections from acute rhinosinusitis. The Laryngoscope. 2012;122.
18. Meshi A, Nemet AY. Periorbital and orbital cellulitis in adults. Journal of Oral and Maxillofacial Surgery, Medicine, and Pathology. 2014;26(4):464-7.

Please cite this paper as: Hasheminia D, Naghdi N, Pourarz S. Orbital and Preseptal Cellulitis: Epidemiology, Etiology, and Management. Regen Reconstr Restor. 2019;4(4): 142-147. Doi: 10.22037/rrr.v4i1.26606