Diagnostic Value ofComputed Tomography Imaging in Orbital Complications of Acute Inflammatory Paranasal Sinuses Diseases

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Abstract

Background:CT has imported role in diagnosis of orbital complications resulting from acute inflammatory paranasal sinuses diseases, as it can detect cause, site of lesion also erosion of bone or not, also it can give feedback about response to treatment or need of surgical interference and also success rate of surgery CT could be with contrast or without contrast for better evaluation of lesion extension and invasion to surrounding structures.The aim of this work is to diagnose orbital complications of acute inflammatory paranasal sinuses diseases by computed tomography. **Patients and Methods:**Cross-sectional study was conducted at Radiology department, faculty of medicine, Zagazig university hospitals for 6 months, this study was included 30 patients.**Results:**Age was distributed as 42.40±17.45 old, regard sex majority were male with 60.0%. The utilized technique the current study showed that 60% of cases were diagnosed by CT and 40% with CT with contrast. The majority were at left with 50% followed by right 30% and finally bilateral with 20%, regard site the majority where Maxillary sphenoid ethmoid with 50% then Maxillary ethmoid was 40% then and finally Maxillary with 10%. Regarding the CT finding distribution among studied group, we found that Opacity in maxillary ethmoid was in 60% and Opacity in Max, sphenoid ethmoid was in 30% and Opacity in maxillary with 10%. We revealed that muscle affection was in 60% and Bone erosion with 50.0% each and soft tissue thickness and Abscess 20.0% each.The majority were Invasive fungal with 40% then Allergic fungal with 30% then Acute bacterial with 20% and Mucocale with 10%. We found that only 6 (20%) were with good prognosis (respond) and 24 (80%) were not responder.**Conclusion:**Complications arising from Acute Inflammatory paranasal sinuses diseases can result in life-threatening illness. Knowing the anatomic relationship of the paranasal sinuses to the orbital and the mechanisms of infectious spread, is paramount for early diagnosis of these complications.

Key words: Computed Tomography Imaging, Orbital Complications, Paranasal Sinuses Diseases

DOI Number: 10.14704/NQ.2022.20.12.NQ77362 **NeuroQuantology2022;20(12): 3547-3555**

Introduction:

A close relationship between diseases of the paranasal sinuses system and the orbit is based on anatomical relationship. Orbital position adjacent to the nose and paranasal sinuses, make it susceptible to the disease from the area. Orbital wall was related to the superior with frontal sinus floor, to the medial with lateral wall of ethmoid sinus, to the inferior with the roof of the maxillary sinus and to posteromedial with anterolateral wall of the sphenoid sinus [(1)].Approximately 60%to 80% of the wall of the orbit formed by the walls of paranasal sinuses. In addition, the frontal sinus floor and the lateral wall of the ethmoid sinus walls were thin so that it has a weak resistance against a mass or an inflammatory process [(2)].

A variety of diseases can involve both the sinonasal cavities and the orbit. It is more common for sinonasal pathology to affect the orbit than the reverse [(3)].

However, distinguishing self-limiting infection from rhinosinusitis with orbital complication can be challenging. If there is clinical suspicional of orbital complication, cross-sectional imaging of the orbit is mandatory [(4)].

Contrast enhanced and/or contrast enhanced MRI should be obtained. Since bony sinus anatomy can be best depicted by CT, CT is often the imaging modality of first choice.

In addition CT is widely available, fast and provides high spetial resolution images. Because of the spead of the acquisition, sedation is usually not required. An important disadvantage of CT is the use of ionizing radiation. In patients that do not require sedation, ceMRI may be preferred over ceCTspecially of CT shows no abnormalities, but the patient as persisting symptoms suspicion for orbital complications [5].The aim of this work is to diagnose orbital complications of acute inflammatory paranasal sinuses diseases by computed tomography.

Patients and Methods

1- Technical designs:

A. Site of the study: Zagazig University Hospitals

B. Sample:

Type: comprehensive sample

Size: All cases with inclusion criteria will be taken in the study. As number of cases will not exceed 5 cases per month so in the study period, it will be 30 patients.

C- **Subjects:**

Patients with Inclusion criteria:

1- Patients with upper and lower orbital edema
2- Patients with orbital pain
3- Patients with ocular motility defect
4- Patients with opthalmoplegia
5- Patients with visual acuity defect

Patients with Exclusion criteria:

1- Patient with allergic reaction to contrast media
2- Pregnant or lactating female
3- Hyperthyroidism or renal insufficiency
4- Patient unwilling to complete the study

D- Tools: All patients are subjected to:

- Complete history taking:
  - Personal history: as regard name, age and sex
  - Present history: regarding the present symptoms like pain odema, ophthalmoplegia and exophthalmos.
- Full clinical examinations
- Imaging including: CT andCT with contrast

2- **Operational design** :

a- **type of the study** : cross sectional for study design

b- **steps of performance** :

1- complete history taking
2- full clinical examination
3- revising imaging results
4- analysis the result
5- preparing conclusion and recommendation

CT technique: All MDCT examinations were performed with a 128-channel MDCT scanner (Philips ingenuity 128) using the following parameters: detector row configuration, 128 x 1 mm; collimation, 1 mm; slice thickness, 1.25 mm; pitch, 1.375; reconstruction interval, 1 mm; 300 mAs; 120 kVp.

To obtain direct axial scans, Patients were scanned in supine position with head first towards the gantry without gantry tilt. No specific patient preparation was required apart of quiet

breathing. MDCT protocol consists of volumetric data acquisition commencing below the mandible and ending when frontal sinuses are cleared. Although the direct coronal images are highly delicate than the reformatted ones, yet, it is too difficult to obtain direct coronal images in traumatic orbital fractures.

Post processing, the scans were reconstructed and reviewed. Multiplanarreconstructions (MRP) were acquired using the machine software in coronal and sagittal planes.

The thin axial slices are transmitted directly from the MDCT scanner to a workstation via the picture archiving and communication system (PACS) for reconstruction of 3D images which are important adjuncts to axial and MRP images for evaluation of spatial relationships. However, 3D images alone should not be used for the detection and characterization of fractures.

Multidetector CT had transformed CT from a trans axial cross-sectional technique into a true 3D imaging modality for arbitrary cut planes as well as excellent 3D displays of the data volume. MultisliceCT scanners provide a huge gain in performance that can be used to reduce scan time, to reduce section collimation, or to increase .scan length substantially.

Contrast injection considerations:

- non-contrast (e.g. foreign body, thyroid disease)
- contrast volume: 70-100 mL
- biphasic injection technique (inflammatory conditions)
    - 50-60 ml contrast media at 1-2 mL/s
    - 40-50 ml contrast media followed by 30-50 ml saline chaser at 2-3 mL/s starting after 60 seconds
    - scan delay: 80-100 seconds
- monophasic injection technique (parotid tumors)
    - 70-1 OOml followed by 30-50 ml saline chaser at 2-3 mL/s
    - Scan delay: 40-50 seconds .

Statistical analysis

Data analyzed using Microsoft Excel software then imported into Statistical Package for the Social Sciences (SPSS version 20.0) software for analysis. According to the type of data qualitative represent as number and percentage, quantitative continues group represent by mean ± SD, the following tests were used to test differences for significance; difference and association of qualitative variable by Chi square test (X^2). Differences between quantitative independent groups by Mann Whitney. P value was set at <0.05 for significant results &<0.001 for high significant result.

Results:

Age was distributed as 42.40±17.45 with minimum 3 and maximum 62 years old, regard sex majority were male with 60.0%**(Figure 1).**Regard Technique CT was 60% and CT with contrast was 40%**(Figure 2).**Regard side the majority were at left with 50% followed by right 30% and finally bilateral with 20%, regard site the majority were Maxillary ethmoid was 40% then Maxillary sphenoid ethmoid with 30% then Maxillary ethmoid sphenoid with 20% and finally Maxillary with 10% **(Figure 3,4).**Opacity in maxillary ethmoid bone erosion was in 40% and Opacity in Max, sphenoid ethmoid was in 30% and Opacity in maxillary ethmoid was 20% and Opacity in maxillary with 10%**(Figure 5).** Majority were Invasive fungal with 40% then Allergic fungal with 30% then Acute bacterial with 20% and Mucocale with 10%(**Figure 6).**There was only 6 (20%) were with good prognosis (respond) and 24 (80%) were not responder(**Figure 7).**

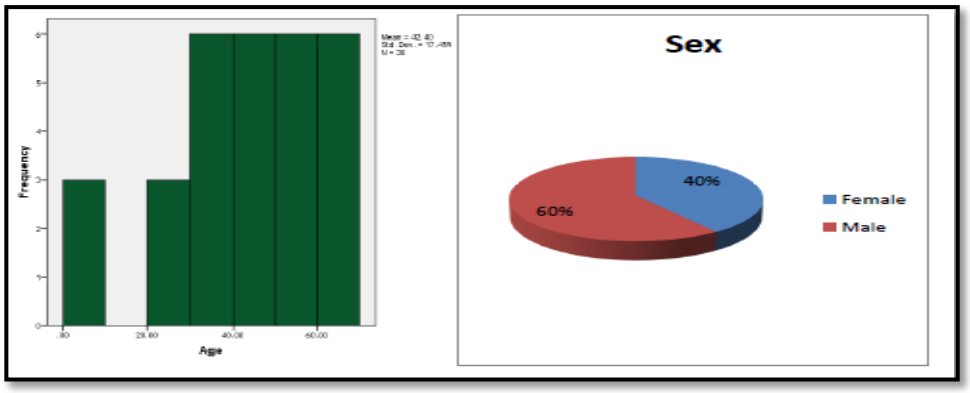


Figure (1): Age and sex distribution among studied group.

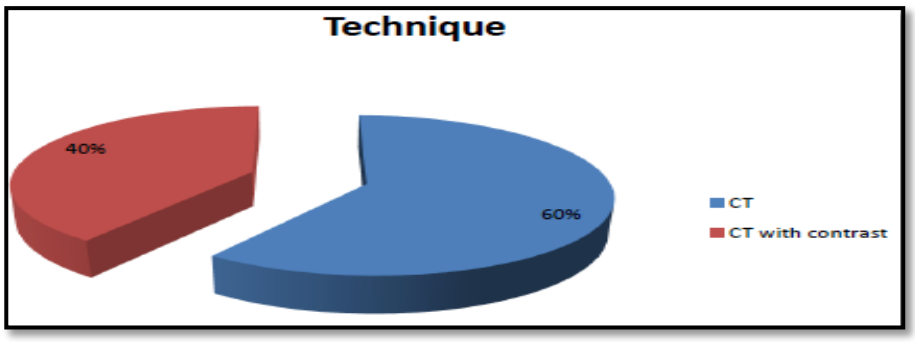


Figure (2): Technique distribution among studied group.

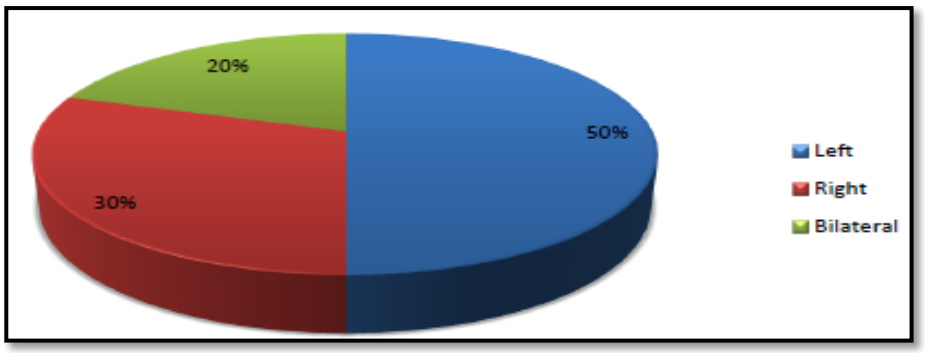


Figure (3): Side distribution among studied group.

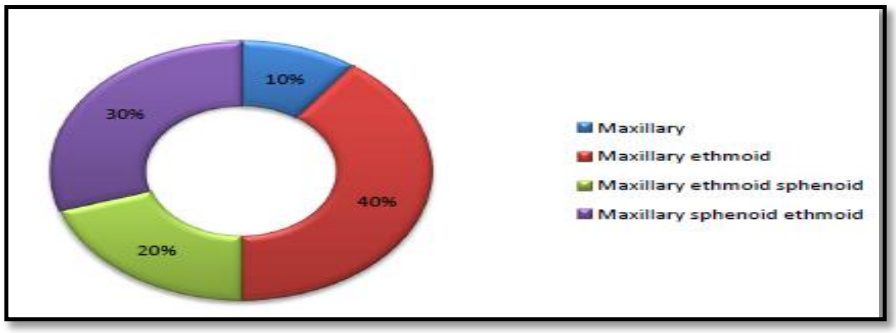
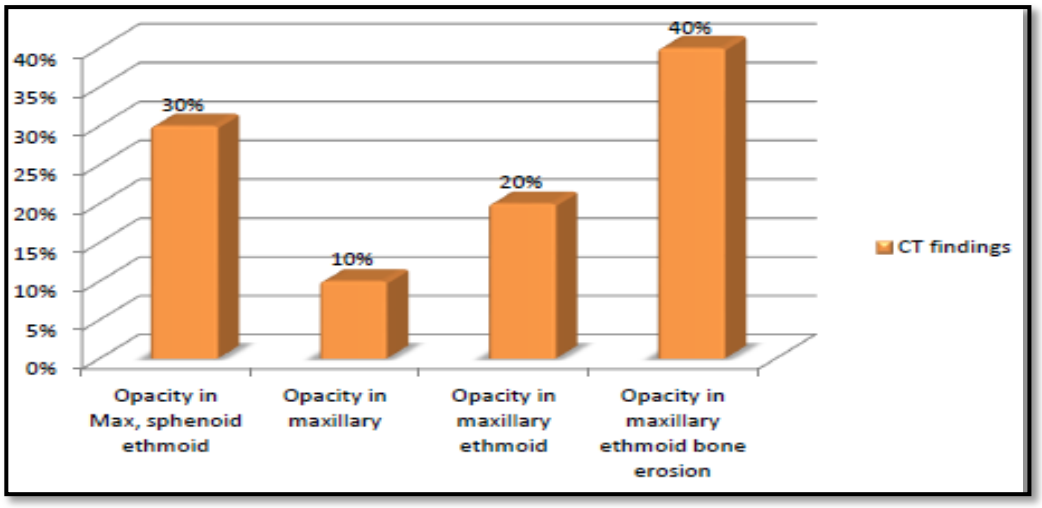


Figure (4): Sitedistribution among studied group.



Figure(5): CT in PNS disease finding distribution among studied group.

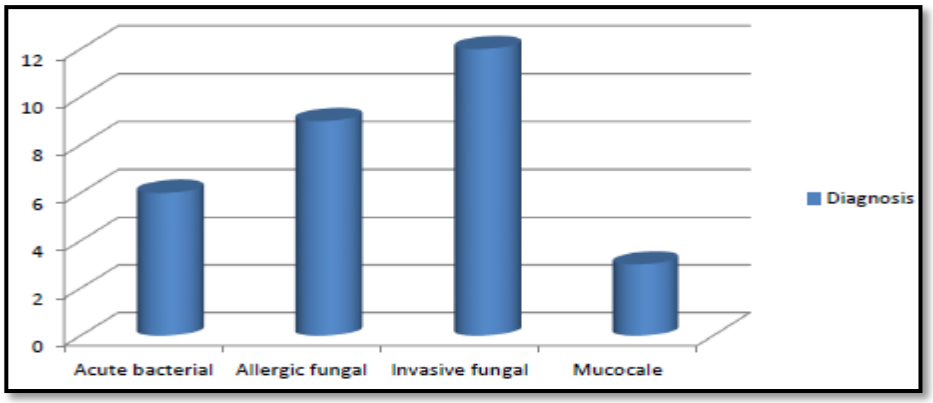


Figure (6): Aetiological distribution among studied group.

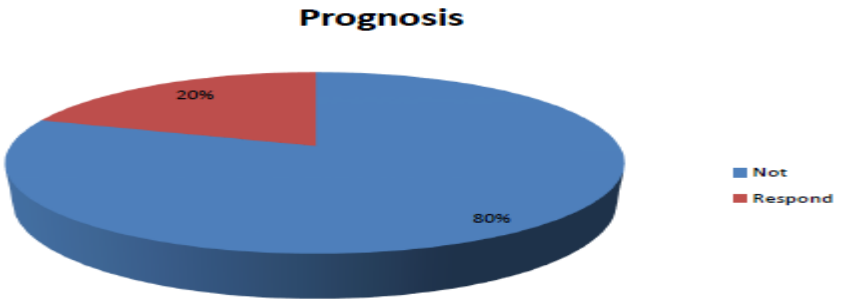


Figure (7): Prognosis distribution among studied group (N=30).

Discussion

Regarding the sociodemographic distribution of the studied group, we revealed that age was distributed as 42.40±17.45 with minimum 3 and maximum 62 years old, regard sex majority were male with 60.0%. While the study by **Bagul et al.,** [6]revealed that the paranasal sinuses pathologies were more common in male (62%) compare to female population (33%). Most common age group affected by the paranasal sinuses pathologies was 11-30 years age group (45.5%) and least common age group was less than 10 years (<2%).

The study by **Rao,** [7]involved 50 patients. 8 patients were less than 20 years of age. 11 patients were between 21-30 years out of them there were 24 (48%) of total patients were females and 26 (52%) of patients were males. 11 patients were between 41-50 years of age. Highest number of patients were in the range of 31-40 yrs. Youngest patient was 8 yrs and eldest patient was 85 years old. **Ibrahim et al.**

eISSN 1303-5150

[8]performed retrospective study on 240 patients suffering from acute rhino-sinusitis. The age of patients ranged from 2 to 45 years, 55% males and 45% females. Whereas the study by **Radovani et al.** [9]investigated 177 cases out of them there were 35 cases (19.8%) of orbital complications with an average age of 25 (range: 3-75).

Regarding the utilized technique the current study showed that 60% of cases were diagnosed by CT and 40% with CT with contrast. Although radiographs may still be used to confirm the clinical impression of sinusitis, computed tomography (CT) is more accurate for making this diagnosis. Indeed, whenever orbital or intracranial complications of sinusitis are suspected, contrast-enhanced CT should be the initial imaging modality of choice [10]**.** While CT and MRI have not been compared directly for accuracy of diagnosing sinusitis complications, contrast-enhanced MRI may, indeed, detect abnormalities that are not detected on CT [11].

The present study showed that symptoms of the sinusitis may include nasal congestion, purulent rhinorrhea, postnasal drainage, headache, cough, facial or dental pain, and fever. Regarding the symptom distribution of the studied cases the current results revealed that the majority were Headache orbital edema and Headache orbital edema + vision affect with 40% each and Headache proptosis was 20%. While the study by **Rao,** [7]revealed that most of the patients had nasal obstruction (60%) followed in decreasing order by headache (56%), nasal discharge (52%). The least common complaint was swelling in facial region.

Regarding the side, our results showed that the majority were at left with 50% followed by right 30% and finally bilateral with 20%, regard site the majority where Maxillary sphenoid ethmoid with 50% then Maxillary ethmoid was 40% then and finally Maxillary with 10%. While the study by **Rao,** [7]revealed that most common sinus involved was anterior ethmoid sinus in 38 (76%) patients, followed by maxillary, posterior ethmoid, frontal and sphenoid sinuses in decreasing order.

The frequency of sinus mucocele localizations is 52–63% for the frontal or ethmoid-frontal sinus, 20–30% for the maxillary sinus, 0–14% for the ethmoid sinus alone, and 4–7% for the sphenoid sinus [12]**.** Maxillary sinus mucoceles are relatively rare, accounting for less than 10% of paranasal sinus mucoceles in Europe, but they are more prevalent in Japan, where it has commonly been reported following CaldwellLuc maxillary sinusectomy. [13]

The most common CT findings in acute fulminant invasive fungal sinusitis include severe soft tissue edema of the nasal cavity mucosa, sinus mucoperiosteal thickening, bone erosion, orbital invasion, facial soft tissue swelling, and retroantral fat pad thickening [10].

Endoscopic / Functional endoscopic sinus surgery findings were similar to CT findings in 44 (88%) patients and different from CT findings in 6(12 %) patients. These different findings were related to either fungal disease or inspissate secretions [7].

Regarding the CT finding distribution among studied group, we found that Opacity in maxillary ethmoid was in 60% and Opacity in Max, sphenoid ethmoid was in 30% and Opacity in maxillary with 10%. Regarding the CT finding of orbit affection, we revealed that muscle affection was in 60% followed by Intracranial fat Inf, Proptosis and Bone erosion with 50.0% each and soft tissue thickness and Abscess 20.0% each. However, **LeBedis& Sakai** [14]revealed that in patients with bacterial rhinosinusitis the abscess will usually be extraconal. On CT, orbital abscess can be seen as a rim-enhancing fluid collection that has sharp angles with the orbital wall.

In the study of **Chang et al.** [15]**,** eighty-three patients aged 9 days to 80 years had stage I (preseptal cellulitis, n = 39 patients), II (postseptal orbital cellulitis, n = 8), III (subperiosteal abscess, n = 16), IV (orbital abscess, n = 8), or V (intracranial involvement, n = 12) complications. Peak incidences occurred in patients aged 0–19 and 60–69 years. Chronic sinusitis and diabetes mellitus were common preexisting diseases. Extraocular movement limitation and proptosis

eISSN 1303-5150

predicted postseptal (stage II or more) involvement.

According to **Radovani et al.** [9], they encountered 35 cases (19.8%) of orbital complications with an average age of 25 (range: 3-75); Palpebral inflammatory oedema[13], orbital cellulitis [9], subperiosteal abscess [16], orbital abscess [17], and cavernous sinus thrombosis (1 patient).

In the study of **Naeini et al.** [18], despite a complete lack of olfaction, there were no significant changes in the paranasal sinuses on CT imaging. Involvement of sinuses on CT analysis was as follows: total Lund-Mackay score was 0 in 41 (83.7%) patients, 1 in 3 (6.1%) patients, 2 in 4 (8.2%) patients, and 4 in 1 (2%) patient. There were no abnormalities in cribriform plate, and no mucosal thickening of the olfactory cleft area was detected in any of the cases.

Fungal sinusitis is broadly divided into noninvasive and invasive forms, with the latter being further subdivided into granulomatous, acute fulminant, and chronic invasive forms. The diagnosis of invasion requires histopathologic evidence of hyphal forms within mucosa, submucosa, blood vessels, or bone. Mucormycosis and Aspergillus, which represent the most common pathogens, have a propensity for angioinvasion[10].

Acute bacterial rhinosinusitis frequently evolves from a viral upper respiratory infection (URI). Of all children seeking medical attention for respiratory symptoms, 6 % -7 % have acute bacterial rhinosinusitis. The most common bacterial agents causing this infection are streptococcus pneumoniae, haemophiles influenza and moxarellacatarrhalis. Early identification of children with complications of acute bacterial rhinosinusitis is crucial since it can cause life-threatening illness by the spread of infection to the orbits and central nervous system. In clinical practice, orbital complications are encountered most frequently [19].

Regarding Diagnosis distribution among studied group, we found that the majority were Invasive fungal with 40% then Allergic fungal with 30% then Acute bacterial with 20% and Mucocale with 10%. **Chang et al.,** reported that CT scanning was performed in 85.5% of their studied patients, and accurately established the diagnosis of sinusitis and the extent of orbital complications [15]. Despite the fact that we mainly relied on clinical and surgical exploration to determine these diagnoses, CT scans played an undisputable role in the determination of a topical diagnosis and the correct differentiation of such pathologies. Therefore, today, follow-ups are expected to be performed every hour via computer imaging in order to track the development of the pathology and to determine the appropriate time for intervention [9].

As regard the prognosis distribution we found that only 6 (20%) were with good prognosis (respond) and 24 (80%) were not responder. Responder cases significantly associated with younger age, female Responder cases significantly associated with younger age, female, Headache proptosis right side, Maxillary ethmoid, Opacity in maxillary ethmoid in CT and with Acute bacterial,Headacheproptosis right side, Maxillary ethmoid, Opacity in maxillary ethmoid in CT and with Acute bacterial. Significant association and agreement between Opacity in Max, sphenoid ethmoid and Allergic fungal also between Opacity in maxillary with Mucocale and between Opacity in maxillary ethmoid and Acute bacterial and Invasive fungal.

While in the study of **Makihara et al.** [13], the patients with ethmoid-frontal mucoceles had a significantly higher incidence of orbital complications (6/9) as compared with the other sub-types of mucoceles (frontal, 0/7; ethmoidal, 0/9; maxillary, 1/62; maxillary-ethmoidal, 0/3; sphenoid, 0/2) (P<0.01). Mucocele compression caused a partial defect of the orbital wall bone (lamina papyracea, or inferior orbital wall bone) in all seven cases. The patients with the orbital wall bone defect had a significantly higher incidence of orbital complications (7/28) than the patients without the defect (0/64) (P<0.01). Chandler's classification showed Type I in one, Type II in three, and Type III in three.

The goals of surgery for orbital complications of sinusitis are to drain the abscess

eISSN 1303-5150

adequately, release pressure in the orbit, and obtain material for culture.7 Endoscopic sinus surgery, introduced in the 1980s, was the most frequently used procedure in the current study. It has several advantages over an open procedure, including the negation of an external wound, less postoperative edema, and more rapid recovery. The likelihood of surgery increased with more advanced stages of orbital complications in the current study [(20)].

It is generally believed that preseptal cellulitis and orbital cellulitis respond to drug treatment alone, but subperiosteal/orbital abscess or intracranial complications require surgical drainage. Several reports indicate that drug treatment alone may be effective for ethmoidal sinusitis-related subperiosteal abscess in some children aged younger than 9 years with intact visual function, provided they meet certain additional criteria. Nevertheless, good clinical judgment should always take precedence and emergency drainage of a subperiosteal abscess may be necessary [(21)].

Orbital complications of sinusitis can lead to blindness and death. Causes of vision-loss include: [(15)].Optic neuritis resulting from a reaction to an adjacent or nearby infection, [(8)] ischemia resulting from thrombophlebitis along the valveless orbital veins.

Conclusion:

Complications arising from Acute Inflammatory paranasal sinuses diseases can result in life-threatening illness. Knowing the anatomic relationship of the paranasal sinuses to the orbital and the mechanisms of infectious spread, is paramount for early diagnosis of these complications.

No conflict of interest.

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