RESEARCH

IMAGING FEATURES OF RHINO-ORBITO-CEREBRAL MUCORMYCOSIS IN POSTCOVID-19 PATIENTS

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Abstract

Background: An alarmingly rising number of instances of rhino-orbito-cerebral mucormycosis, a lethal invasive fungal illness, have been seen among the covid-19 survivors during the second wave in India. This disease is often found in immunocompromised individuals and in those with uncontrolled diabetes. Though the cause is said to be multifactorial the important cause is said to be the use of steroids by the patients without adequate medical supervision. The aim is to using data from 19 individuals with rhinocerebral mucormycosis, consistent radiographic characteristics were identified that might aid in the early identification of this condition. **Materials and Methods:** A six-month, cross-sectional research carried out at the MGM Hospital in Warangal from May 2021 to October 2021. The 1.5 tesla GE MR SIGNA MRI machine and GE BRIGHTSPEED 16 slice CT unit were used to examine all patients suspected of having acute invasive fungal sinusitis who were either covid-19 positive or had recovered from covid-19 infection. Contrast study is done whenever indicated. **Result:** A total of 81 patients were imaged. On CT scans 23 patients (28.4%) had hyperdense lesions, 36 patients (44.4%) had hypodense lesions and 22 patients(27%) had isodense lesions. On MRI 56 patients (69%)had hyperintense signal and 25 patients (31%) had hypointense signal on T2-Weighted images. **Conclusion:** Mucormycosis is fatal invasive fungal disease which has the propensity to invade the periantral regions, pterygopalatine and sphenopalatine regions, orbits, skull base and in some cases causing fungal abscess in the brain. Imaging is essential for early diagnosis and prompt treatment, which significantly lowers morbidity and death.

INTRODUCTION

A new strain of the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) has taken over the global health landscape for the rest of 2019 and 2020. Along with severe pneumonia, SARS-CoV-2 is also linked to strokes, venous thrombosis, renal failure, cardiomyopathy, coronary and systemic vasculitis. Approximately 1.61 million people have died as a result of the virus, which has impacted approximately 72.3 million people worldwide to date.9.8 million Indians have the disease, and more than 143,000 have died as a result.[1,2] We have seen a sharp rise in referrals for rhino-cerebro-orbital mucormycosis during the previous eight months.

Rhino orbito-cognitive Mucormycosis is regarded as a lethal invasive illness brought on by a fungus of the class Phycomycetes that mostly affects immunocompromised individuals and typically begins in the nasal cavity and paranasal sinuses. As a consequence of the sickness, deep craniofacial structures such as the orbit, cavernous sinus, and brain may become contaminated. The key factor thought to produce arterial thrombosis and tissue necrosis is extensive angioinvasion. It is a fatal opportunistic illness that primarily affects diabetics, disabled people, and those with impaired immune systems. The frequency of post-covid patients is increasing, which may be caused by the use of high dosages of steroids in combination with uncontrolled diabetes. Imaging is critical for early diagnosis and therapy.[3,4] Collect and analyse information on maxillofacial/rhino-cerebro-orbital fungal infections that were reported at the time of the Covid-19 patients with this disease in order to discover common radiographic abnormalities that might be useful in predicting the diagnosis of this sickness.

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MATERIALS AND METHODS

A six-month, cross-sectional research carried out at the MGM Hospital in Warangal from May 2021 to October 2021. All patients admitted to MGM Hospital with acute invasive fungal sinusitis suspicions who were either coronavirus positive or had recovered from coronavirus infection were included in the study. Imaging features of 81 patients [22 females and 59 males] were studied using 16 slice CT and 1.5T MRI system. CT images were analysed for density and bone involvement, whereas MRI images were evaluated for signal intensity and soft tissue infiltration.

One or more of the following symptoms were present in the patients: face cellulitis, maxillary sinusitis, headache, necrosis of the palatal bone or mucosa, or sudden loss of eyesight. They either had a history of prior COVID-19 infection or had tested positive for the virus when they were admitted, according to a reverse transcriptase polymerase chain reaction (RT-PCR) test. Corticosteroids were used to treat every instance as part of the typical Covid 19 medication regimen.

Routine blood tests and a chest X-ray were performed in addition to determining the COVID-19 status, and any further investigations were driven by the requirements of the individual patient. The face (including the orbits) and brain underwent magnetic resonance imaging (MRI) or computed tomography (CT) in each instance.

A Microsoft Excel spreadsheet was filled up with unprocessed data. It was important to compare qualitative and quantitative data using proper statistical tests, which were carried out with the help of SPSS 17A and openepi.com. The qualitative data was represented by numbers and percentages.

RESULTS

The majority of patients complained of headaches, one-sided face discomfort, and eye and eyelid pain. Few presented with nasal discharge, nasal obstruction and blurring of vision.

Table 1: Age and gender distribution in present study

Age (in years)	No of patients	Percentage
30-40	22	27.16%
41-50	30	37.04%
51-60	25	30.86%
61-70	4	04.94%
Sex		
M	59	72.84%
F	22	27.16%

Of the 81 patients, On CT scans 23 patients (28.4%) had hyperdense lesions, 36 patients (44.4%) had hypodense lesions and 22 patients (27%) had isodense lesions. Bony thinning & erosions seen in 51 patients (63%) with skull base involvement seen in 7 patients and hard palate involvement seen in 3 patients. On T2-Weighted MRI images, 56 patients (69%) showed hyperintense signal and 25 patients (31%) had hypointense signal. Abnormal areas of diffusion restriction with adc reversal noted in 58 patients (72%). Periantral fat infiltration seen in 44 patients (54%), orbital involvement seen in 42 patients (52%), optic nerve involvement seen in 8 patients (9%) and brain involvement seen in 10 patients (12%).

Nasal cavity, maxillary, and ethmoidal sinuses showed a pattern of anatomic involvement most often, with varying involvement of sphenoid sinus, frontal sinus, orbit, skull base, and intracranial structures.

Table 2: Radiological Image Findings

S.No	Age/ Sex		CT		MRI						
	Age	Sex	Density	Bone Erosion/ Thinning	T1WI	T2WI	DWI	Periantral fat infiltration	Orbital inv	Optic nerve inv	Cerebral inv
1	30	F	Hypo		Hypo	Hyper					
2	65	F	Hyper	Yes	Hypo	Hypo	yes	yes	yes		
3	65	F	hypo		Hypo	Hyper	yes	yes			
4	36	F	hyper	Yes	Hyper	hypo	yes	yes	yes		
5	35	F	hypo		Hypo	Hyper					
6	45	F	hyper	Yes	Hypo	Hyper		yes	yes		Abscess
7	52	F	hypo	Yes	Hypo	hyper	yes	yes	yes		
8	35	F	hypo		Hyper	Hyper	yes	yes			
9	40	F	iso		Hypo	Hyper					
10	36	F	iso	Yes	Hypo	hypo	yes	yes			
11	50	F	iso		Hypo	Hyper	yes	yes			
12	50	F	hypo		Hypo	Hyper					
13	50	F	hypo	Yes	Hypo	Hyper	yes	yes			
14	50	F	hyper		Hypo	Hyper	yes				
15	60	F	iso		Hypo	Hyper		yes			
16	59	F	hypo	Yes	Hypo	Hyper	yes		yes	Infarction	
17	39	F	hypo	Yes	Hypo	Hyper		yes	yes		
18	55	F	hyper	Yes	Hypo	Hyper	yes	yes			

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19	49	F	hypo	Yes	Hypo	Hyper	yes				
20	54	F	hyper		Hyper	Hypo			yes		
21	59	F	iso	Yes	Hypo	hypo	yes	yes	yes		Acute Infarct
22	70	F	iso		Hypo	Hyper	yes		yes		
23	47	M	iso		Hypo	Hyper	yes				
24	35	M	hypo		Hyper	Hyper					
25	63	M	iso	Yes	Hyper	Hyper	yes	yes	yes		
26	45	M	iso	Yes	Hypo	Hyper		yes	yes		
27	40	M	hyper		Hyper	Hypo	yes				
28	40	M	hyper	Yes	Hyper	hypo	yes		yes		
29	35	M	hyper	Yes	Hypo	hypo	yes	yes	yes		
30	60	M	hyper	Yes	Hypo	hypo	yes	yes	yes		
31	55	M	hyper	Yes	Hyper	hypo	yes		yes	Optic Neuritis	Acute Infarct
32	42	M	hyper	Yes	Hyper	hypo	yes	yes	yes		
33	45	M	iso	Yes	Hyper	hypo	yes				
34	55	M	hyper	Yes	Hypo	Hypo	yes		yes		
35	30	M	hypo		Hypo	Hyper					
36	50	M	hypo	Yes	Hypo	Hyper	yes	yes	yes		Meningitis
37	58	M	iso	Yes	Hypo	Hyper		yes	yes		
38	50	M	hyper		Hypo	Hyper					
39	50	M	hyper	Yes	Hypo	hypo	yes	yes	yes		
40	47	M	hyper		Hyper	hypo	yes				
41	50	M	hyper		Hyper	hypo	yes				
42	45	M	hypo	Yes	Hyper	Hyper	yes	yes	yes		
43	39	M	hypo	Yes	Hypo	Hyper	yes	yes	yes		
44	50	M	iso	Yes	Hypo	Hyper	yes	yes	yes	Infarction	
45	58	M	hypo		Hypo	hypo	yes	yes	yes		
46	40	M	hypo	Yes	Iso	Hyper	yes				Acute Infarct
47	36	M	iso	Yes	Iso	Hyper	yes	yes	yes		
48	43	M	iso	Yes	Hypo	Hyper					
49	60	M	iso		Iso	Hyper	yes				
50	45	M	hypo	Yes	Hypo	Hyper	yes	yes	yes		cerebritis
51	48	M	hyper	Yes	hypo	Hyper	yes	yes			cerebritis
52	43	M	iso	Yes	Iso	Hyper		yes			
53	51	M	hypo		hyper	Hyper	yes				
54	45	M	iso	Yes	Hypo	Hyper		yes			
55	42	M	hyper	Yes	Hypo	Hyper		yes	yes		cerebritis
56	60	M	iso	Yes	Hyper	hypo	yes	yes	yes	Infarction	
57	32	M	hypo		Hypo	Hyper	yes				
58	58	M	iso	Yes	Hyper	hypo	yes	yes	yes		
59	45	M	hypo		Hypo	Hyper	yes	yes			
60	37	M	hypo	Yes	Hyper	Hyper			yes		
61	60	M	hypo	Yes	Hypo	hyper	yes	yes			
62	42	M	hypo		Hyper	hypo	yes				
63	58	M	iso		Hypo	hyper					
64	53	M	hyper	Yes	Hyper	hypo	yes	yes	yes		Acute Infarct
65	50	M	hypo	Yes	Hypo	Hyper		yes	yes	Infarction	
66	45	M	hypo		Hyper	Hyper	yes		yes		
67	56	M	hyper	Yes	Hyper	Hypo	yes		yes		
68	60	M	hypo	Yes	Hyper	Hyper	yes	yes	yes		
69	60	M	hypo	Yes	Hypo	Hyper	yes	yes	yes		
70	51	M	hypo	Yes	Hypo	Hyper	yes			Infarction	
71	36	M	iso		Hyper	Hyper					
72	40	M	hypo	Yes	Hypo	Hyper		yes	yes		
73	50	M	hypo		Iso	Hyper					
74	45	M	hypo		Hypo	Hyper					
75	49	M	hypo	Yes	Hypo	Hyper			yes		
76	37	M	hyper	Yes	Hyper	Hypo	yes		yes		
77	54	M	hypo	Yes	Hyper	Hyper	yes		yes		
78	38	M	hypo	Yes	Hypo	Hyper	yes	yes	yes		
79	53	M	hypo		Hyper	hypo	yes	yes			
80	32	M	Iso	Yes	Hypo	hyper	yes	yes			abscess
81	55	M	hyper	Yes	Hyper	hypo	yes	yes	yes		

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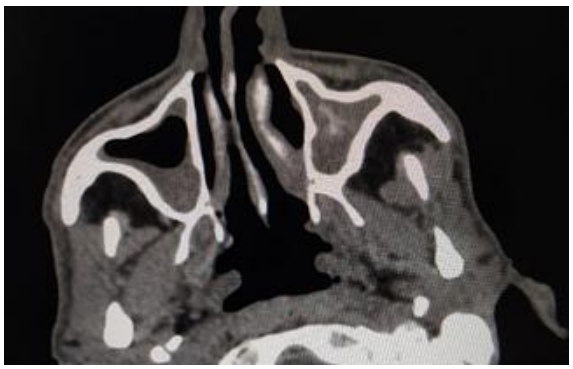
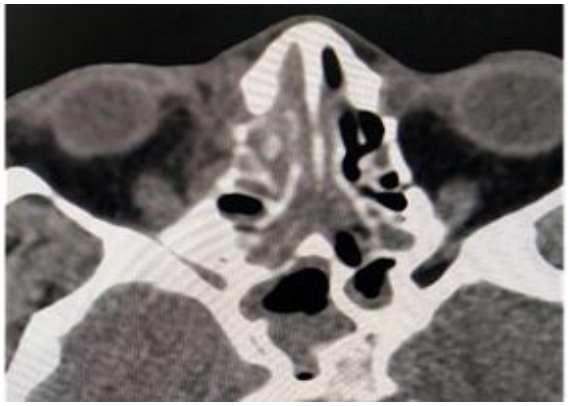
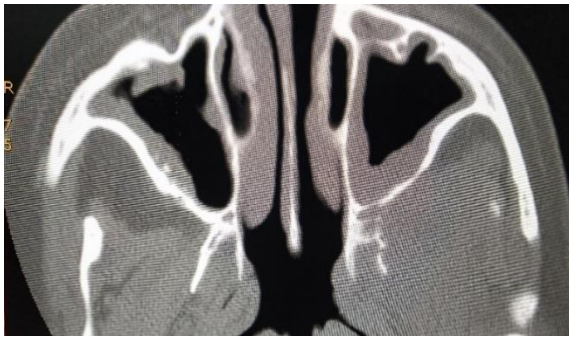


Axial plain CT soft tissue window shows internal hyperdensity within mucosal thickening of maxillary sinuses

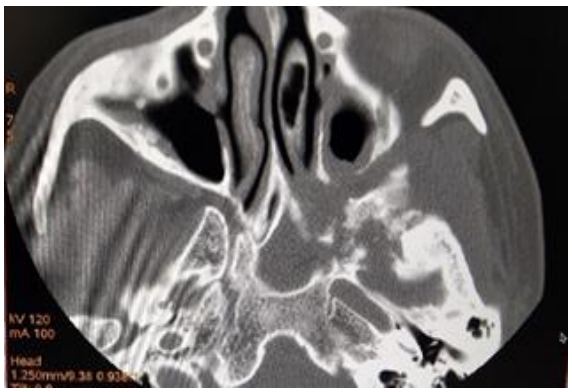


Axial plain CT soft tissue window shows mucosal thickening in bilateral ethmoid sinuse

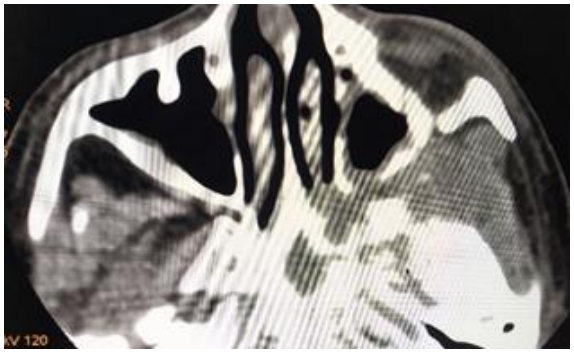


Left maxillary sinus and lateral pterygoid plate erosion are seen in the axial CT bone window.

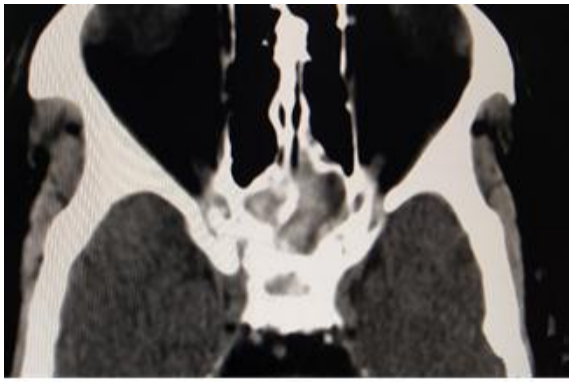
Alveolar process and hard palate erosion are seen in the axial CT bone window.



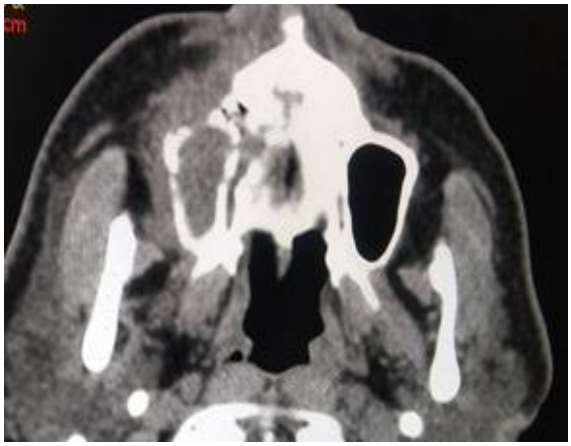
Left maxillary, sphenoid, and sphenoid sinus erosions are seen in the axial CT bone window.



Axial CT soft tissue window reveals infiltration of left periantral fat.



Sphenoid sinus hyperdensity is seen in the axial CT soft tissue window.



An isodensity with right maxillary sinus erosions and periantral fat infiltration is seen in the axial CT soft tissue window.

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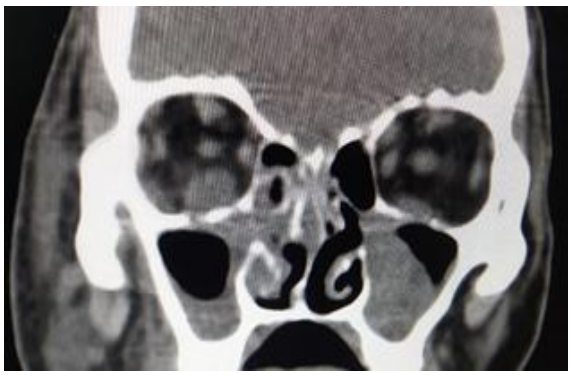
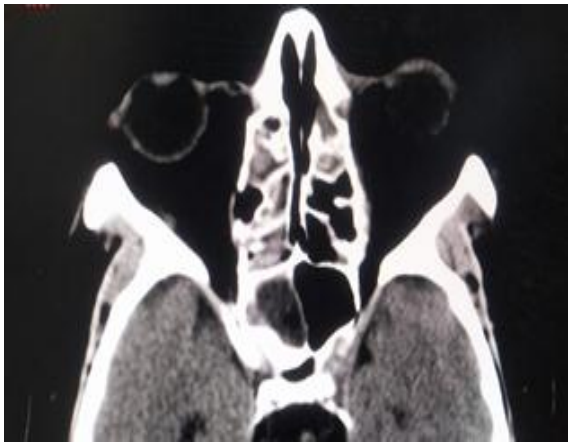
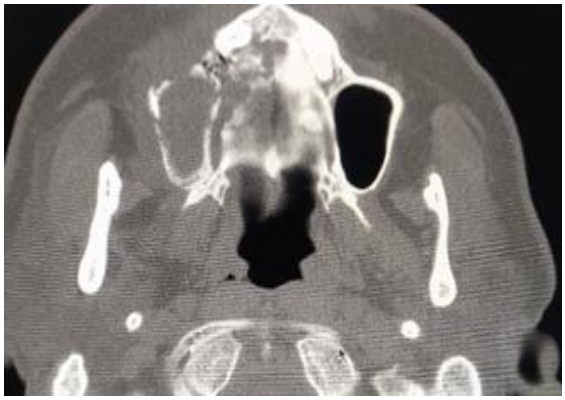


Right orbital infiltration with a large inferior rectus is seen in the soft tissue window of the coronal CT scan.

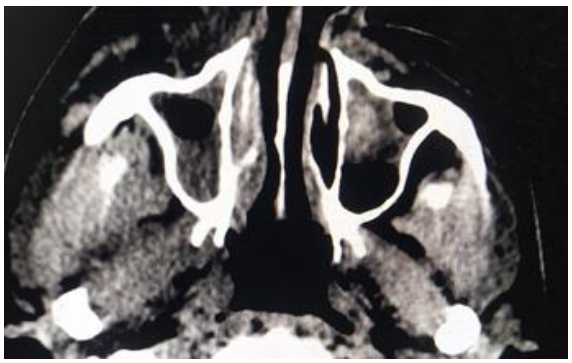


Bilateral ethmoid sinuses have hyperdensities visible in the axial CT soft tissue window.

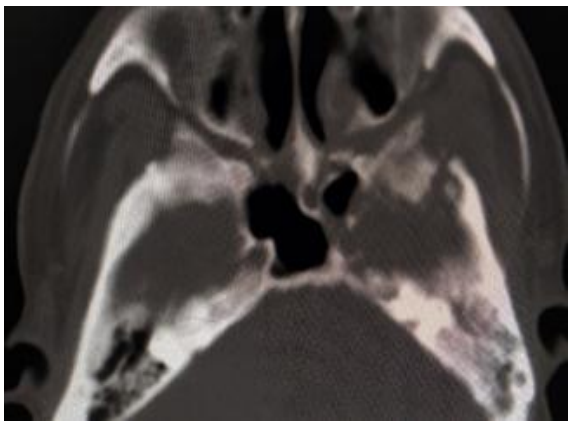
Left maxillary sinus erosion is seen in the axial CT bone window.



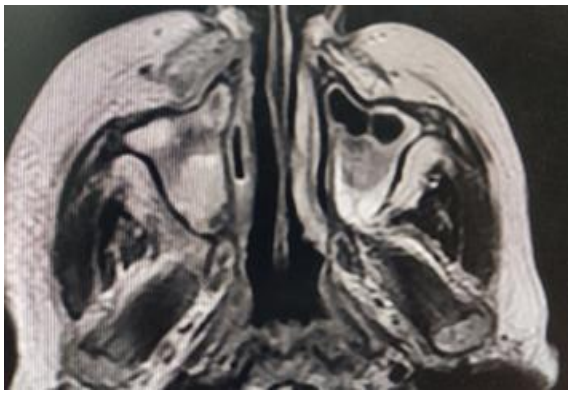
Right maxillary sinus and hard palate erosion are seen in the axial CT bone window.



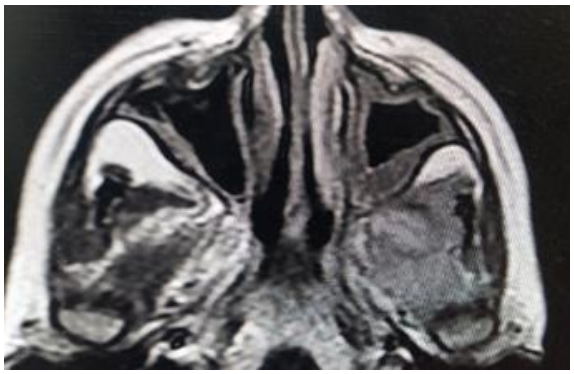
Maxillary sinus hyperdensity inside hypodense mucosal thickening is seen in the Axial CT Soft Tissue Window.



Erosion of the left sphenoid bone and petrous apex may be seen in the axial CT bone window.



An axial T2W MR scan reveals thickening of the mucosa in both maxillary sinuses.



Axial T2W MR image shows hypointense signal in left maxillary sinus, periantral fat and pterygoid muscle infiltration.

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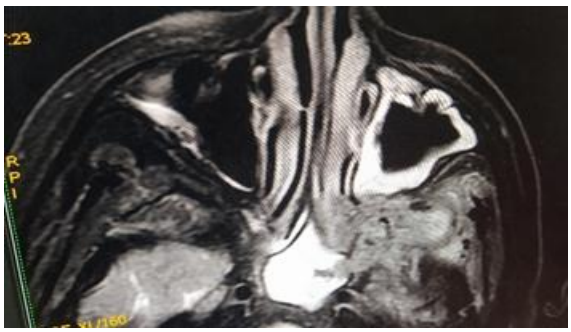
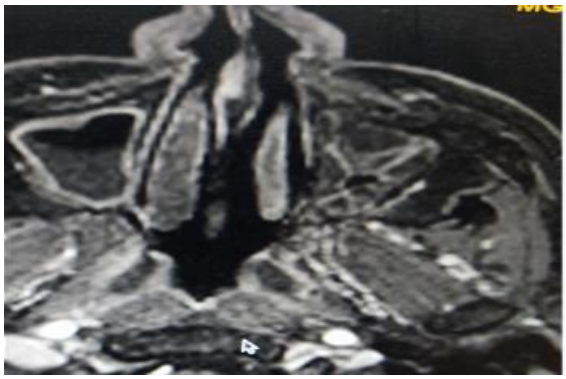
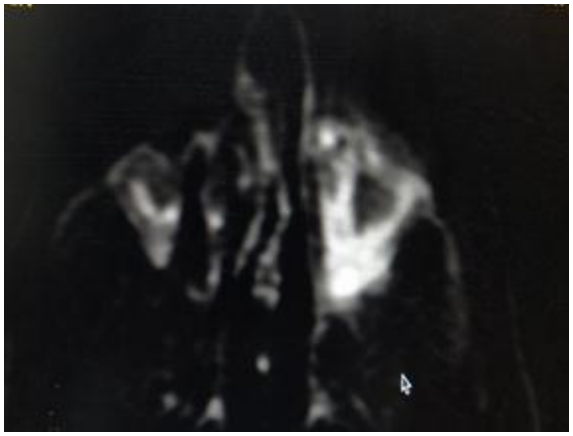


Axial T2W MR scan demonstrates infiltration of the left infratemporal fossa and hyperintense mucosal thickening in the left maxillary sinus and sphenoid sinus.

Coronal T2W MR image shows hyperintensity in bilateral maxillary and ethmoid sinuses with right inferior turbinate hypertrophy and infiltration of left orbit.



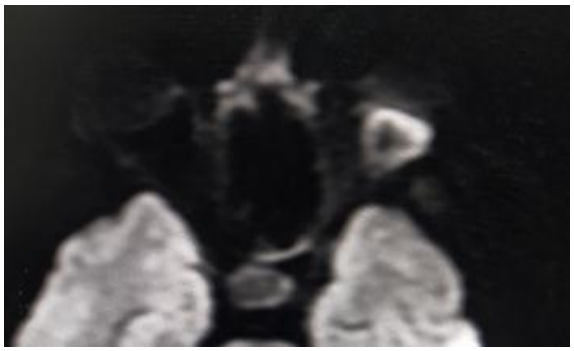
Axial post-contrast T1W MR picture of the left maxillary sinus demonstrates peripheral rim enhancement.



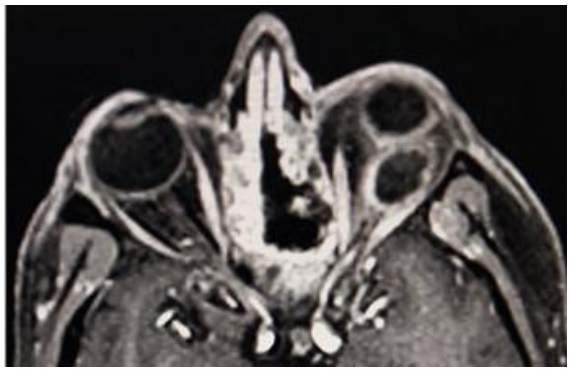
Axial MR image shows diffusion restriction in left maxillary sinus

Coronal post contrast T1W image shows BLACK TURBINATE SIGN involving left inferior turbinate

Axialpost contrast T1W image shows peripheral rim enhancement in right maxillary sinus and a rim enhancing lesion in left orbit (intra conal abscess)



Axial MR image shows abnormal diffusion restriction in left orbit



The same patient's axial post-contrast T1W picture reveals heterogenous enhancement in the ethmoid sinuses and an intraconal abscess in the left orbit.

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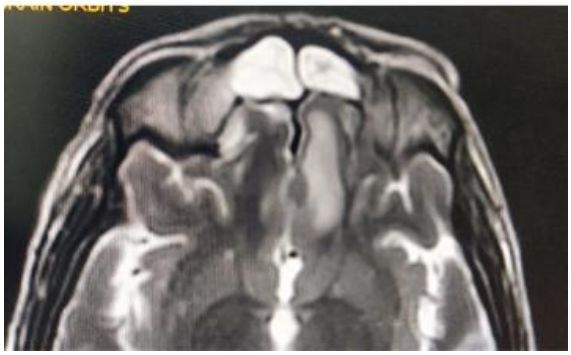
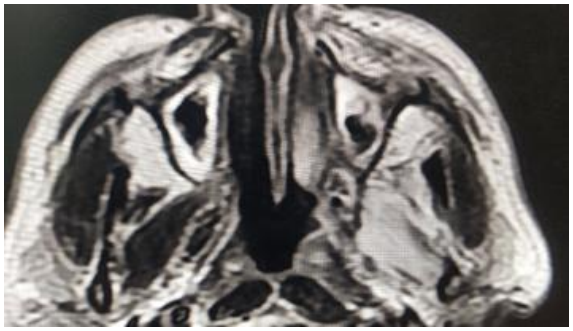
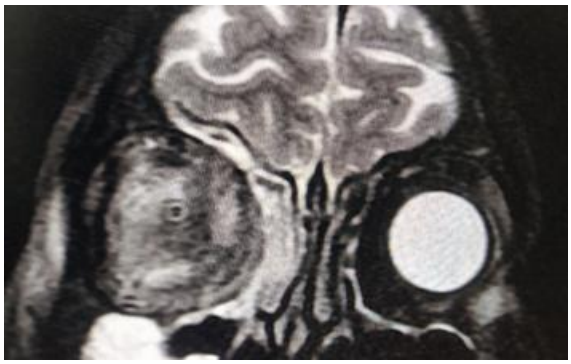


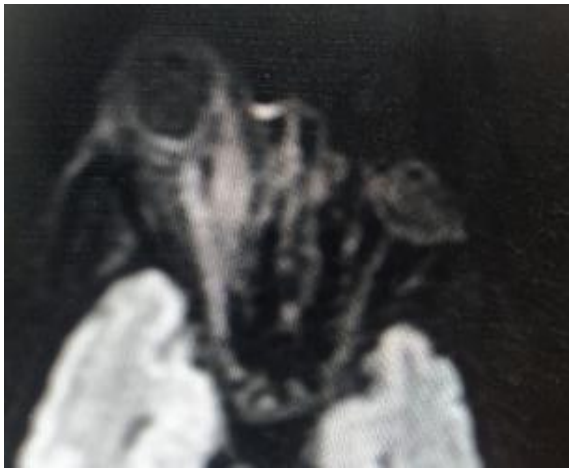
An region of hyperintensity can be seen in the left basifrontal lobe and bilateral frontal sinuses on an axial T2W MR picture.



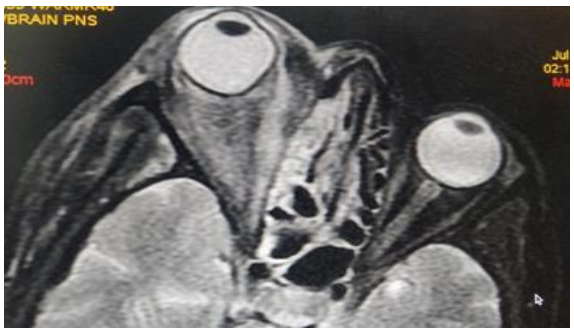
An region of hyperintensity can be seen in the left basifrontal lobe and bilateral frontal sinuses on an axial T2W MR picture.



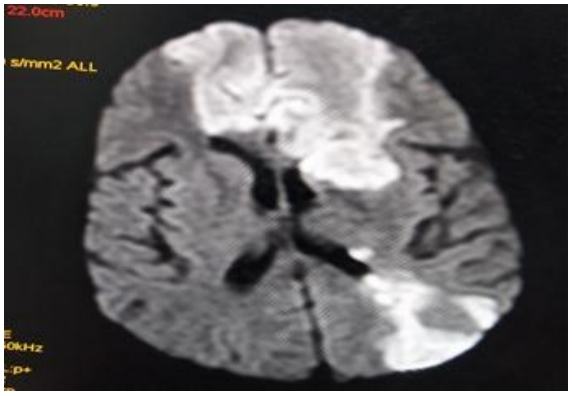
Coronal fat suppressed T2W image shows right intra and extra conal orbital infiltration with extraocular muscle involvement



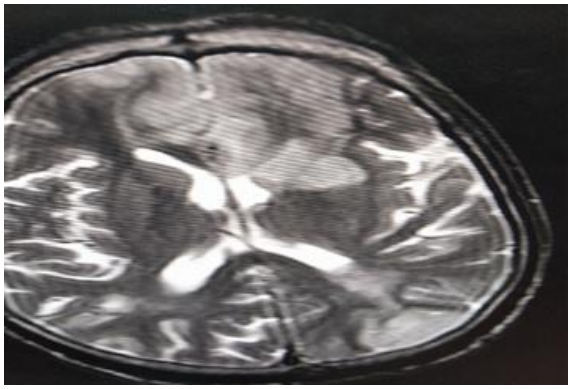
Axial MR image shows abnormal diffusion restriction in right optic nerve and medial rectus muscle



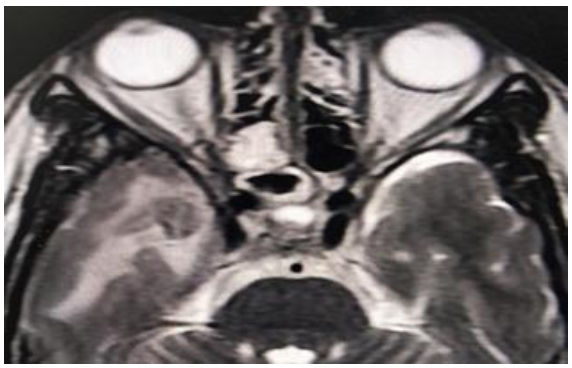
Axial fat suppressed T2W image shows right intra and extra conal orbital infiltration with proptosis of right eye and with guitar pick sign.



Axial MR Image shows diffusion restriction in bilateral basifrontal lobes, left CGR and left occipito-temporal lobe(acute infarct)



Axial T2W Image shows areas of hyperintensity in bilateral basifrontal lobes, left CGR and left occipito-temporal lobe



An axial T2W image reveals right temporal lobe edoema and a well-defined heterogenously hypointense lesion with thickening of the mucosa in both ethmoid sinuses.

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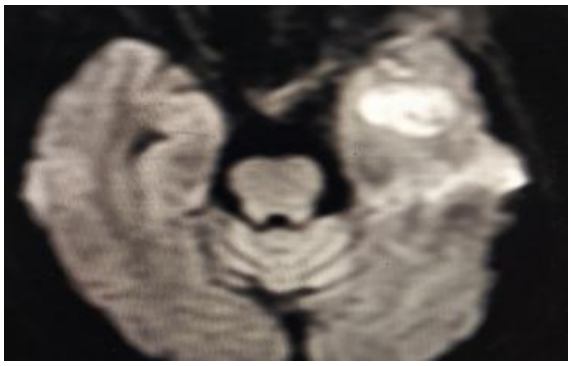
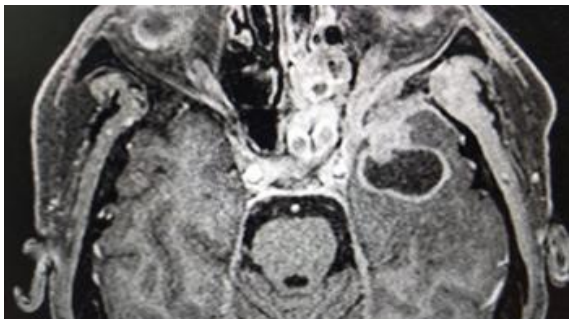
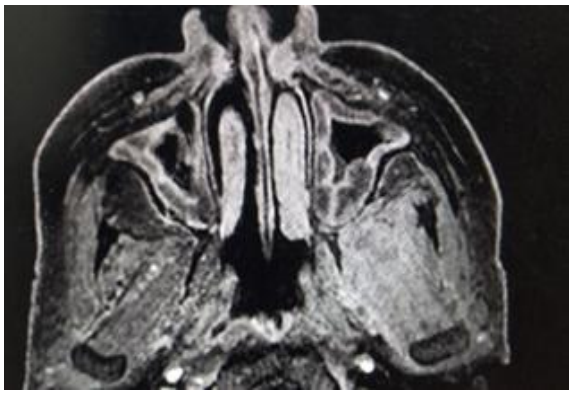
Axial T2W Image shows well defined hyperintense lesion with surrounding edema in left temporal lobe



Same patient lesion shows diffusion restriction on DWI



A well-defined ring-enhancing lesion can be seen in the left temporal lobe and heterogenous enhancement can be seen in the left ethmoid sinuses on an axial postcontrast T1W image.



Axial post-contrast T1W image shows aberrant enhancement in the left pterygoid muscles and infratemporal fossa together with heterogenous enhancement in the bilateral maxillary sinuses.

Figure 1: Radiological Image Finding

DISCUSSION

Cohnheim originally documented a Mucor fungus infection in 1865, reporting a broad illness affecting the ear, lung, and stomach. In 1885, Paltauf reported the second incident. Gregory et al. recorded three cases of rhino-orbito-cerebral mucormycosis in individuals with uncontrolled diabetes mellitus who had unilateral orbital cellulitis, severe opthalmoplegia, and cerebral tissue invasion in 1943. Since then, the name rhinocerebralmucormycosis has been suggested by Baker et al.

Mucormycosis, also known as zygomycosis or phycomycosis, is a rare and deadly disease that often affects persons with untreated diabetes and immunodeficiency.

It is brought on by one of the Absidia, Mucor, or Rhizopus species of the Mucorceae family.

In immunocompromised patients with uncontrolled diabetes, acute and chronic renal failure, hemodialysis using deferoxamine, burns, immunosuppressive drug use, solid organ transplantation, intensive chemotherapy and radiation therapy, AIDS, etc., mucormycosis is a fatal disease with a high mortality rate. Invasive infection is also a risk for patients with hematologic malignancy, iron overload, and hematopoietic stem cell transplantation.

It is a deadly fungal infection in 20-80% of cases. It has a low incidence rate, ranging from 0.005 to 1.7 cases per million persons, but its prevalence has increased dramatically in the context of the current coronavirus epidemic. Mucor is a saprophytic fungus defined by large, non-septate hyphae with virtually right angle branching. Its spores may be found all throughout nature and are spread via soil, air, food, and decaying organic matter. Infection often spreads via direct skin contact or inhalation through the respiratory route. The immunologic actions of macrophages, neutrophils, and complements prevent the multiplication of spores when a person has a healthy immune system. However, in immune-suppressed individuals, fungi quickly multiply and trigger the typical tissue reactions such thrombus development, infarction, and necrosis.[3,4]

Mucormycosis has a wide range of clinical symptoms and may be categorised as rhino-orbital-cerebral, pulmonary, cutaneous, gastrointestinal, disseminated, and other forms. Rhino-orbital-cerebral mucormycosis is frequent in diabetic people. It may exist as a commensal in the nasal mucosa of healthy individuals due to its low virulence potential. This fungus may start to grow in the paranasal sinuses if the patient develops an immunosuppressive state and then spread intracranially or to other adjacent structures, such the orbit. The orbital plates facilitate the transmission of ethmoid sinus infection to the orbit, extraocular muscles, eye, and ophthalmic nerve. Through the ethmoid veins or ophthalmic veins, the infection may ultimately spread to the brain and the cavernous sinus. The severity of cephalic

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mucormycosis and the extent of mucormycosis infection are well documented to vary widely. This was previously addressed by Mohindra and colleagues,[5] who showed how MRI may detect vascular abnormalities such as ischemia and cavernous sinus invasion.

Some people continue to experience the symptoms of a rare condition, such mucormycotic sinusitis. Others could have a more complex form that advances quickly. Cephalic mucormycosis often spreads by bloodstream transmission and direct local invasion. A distant brain abscess or septic (mycotic) cerebral embolism and infarction may ensue from the fungus spreading hematogenously. The effectiveness of the host's defensive systems is crucial. Patients often come with an abrupt initial presentation of headache, fever, facial edoema, sinusitis, and orbital apex syndrome with impaired vision. Neurologic deficits may arise as a consequence of the formation of an intracerebral abscess and septic thrombosis of major intracranial arteries. The fungus quickly spread into the orbits, deep face, and cranial cavity after infecting the immunocompromised or diabetic host and creating a necrotizing vasculitis of the nose and sinuses. A suppurative arteritis, vascular thrombosis, and infarction of the surrounding tissues ensue from the fungus invading the perivascular, perineural, or directly into the soft tissues. Survival rates range from 50% to 80% when just a little amount of paranasal sinus involvement is present, but if cerebral extension has taken place, mortality is higher than 80%. Because it may be fatal, it has to be detected quickly and promptly treated.[6,7,8]

The imaging results of rhinocerebralmucormycosis on CT and MR imaging are diagnostic in the proper clinical situation. In decreasing order of incidence, there is a lack of fluid in the maxillary, ethmoid, frontal, and sphenoid sinuses, as well as soft-tissue opacification of the sinuses with hyperdense material. Because the fungal components include iron and manganese, the sinus contents display a variety of MR signal patterns, including T2 hyperintensity or substantial hypointensity on all sequences. Infratemporal, pterygopalatine, pterygomaxillary, and periantral fat planes often lose their natural fat planes due to soft tissue infiltration of the deep face. Infarcts caused by arterial thrombosis, mycotic emboli, and brain abscesses are examples of intracranial findings.[9,10,11]

CONCLUSION

Mucormycosis is fatal invasive fungal disease which has the propensity to invade the periantral regions, pterygopalatine and sphenopalatine regions, orbits, skull base and in some cases causing fungal abscess in the brain. Imaging is essential for early diagnosis and prompt treatment, which significantly lowers morbidity and death.

An understanding of the different types of fungal sinusitis and knowledge of their particular radiologic features allow the radiologist to play a crucial role in alerting the clinician to use appropriate diagnostic techniques for confirmation. Prompt diagnosis and initiation of appropriate therapy are essential to avoid a protracted or fatal outcome.

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