Original Research Article

# An Observation of Imaging study in Rhino-orbital-cerebral Mucormycosis

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## Abstract

**Introduction**: Amidst this SARS-COV2 pandemic, epidemic outbreak of Mucor-mycosis is being noted in various parts of the World especially in India of which commonest being rhino-orbito-cerebral mucor-mycosis. Suspected mucor-mycosis requires urgent intervention, because of often rapidly progressive and destructive nature of the infection. The purpose of our study is to describe the radiological feature observed in the COVID-associated mucormycosis.**Aim**: To obseve the benefits of CT Scan Vs MRI in management of Mucormycosis.**Methods:** We prospectively observed the plain CT and Gadolinium contrast enhanced MRI of Paranasal sinuses, orbit and brain for 20 patients with clinical suspicion of rhino-orbital-cerebral mucormycosis.**Results:** In MRI, all the patients had Hypointense lesion in T1W Fig, but the signal intensity characteristics of T2W I variable with most common being hypo-intensity (50%) followed by hetero-intense (30%) and hyper-intense (30%). In Post-contrast enhancement pattern, 15% of patient had non-enhancement, while 30% had heterogenous and peripheral enhancement each and 25% had homogenous enhancement. The most common paranasal sinus to get involved is maxillary sinus (90%) and least common being frontal sinus (30%). Orbit (65%) was the commonest extra-sinus site to get involved. In 10% and 5% of patient cavernous sinus thrombosis and internal carotid artery thrombosis was noted respectively. 30% of patient had cerebral parenchyma involvement. For 30% of patient osseous involvement was noted in CT scan.**Conclusion:** Rhino-orbital-cerebral mucor-mycosis is an acute and fatal infection with higher mortality rate due to its rapidly spreading nature. To decrease the mortality rate, early diagnosis and intervention is needed. MRI prevails over CT scan in all the aspects (perineural, base of skull, intracranial and intra-orbital changes detection) except for osseous involvement for which CT scan is needed.

**Keywords:** Rhino-orbital-cerebral mucormycosis, CT Scan, contrast-enhanced MRI



## Introduction

Amidst this SARS-COV2 pandemic, epidemic outbreak of Mucor-mycosis is being noted in various parts of the World especially in India. Mucor-mycosis is a life-threatening angio-invasive fungal infection mostly observed in patients with uncontrolled Diabetes-mellitus and immunocompromised patients. Suspected mucor-mycosis requires urgent intervention, because of often rapidly progressive and destructive nature of the infection[1]. CT Scan and MRI are both used to capture Figs. The CT Scan use X-Ray while MRIs use Radio waves. Both are relatively at low risk but there are differences that make each one a better option depending on the circumstances. Outcome of late stage of infection remains poor despite treatment, hence early diagnosis with CT & MRI of paranasal sinuses, orbit and brain, fungal culture and sensitivity is highly important for the course of the disease and patient survival [2].

**Aim**

To obseve the benefits of CT Scan Vs MRI in management of Mucormycosis.The purpose of our study is to describe the radiological feature observed in the COVID-associated mucormycosis.

**Material & Methodology**

**Study Area:**Central emergency, Department of Otorhino-laryngology, Rajendra Institute of Medical Sciences(RIMS), Ranchi.
**Study Design:** Observational cross- sectional study
**Study Period:** Conducted during the month of May,2021
This observational study was conducted on the suspected cases of mucor-mycosis who were all attending the Central emergency under department of Otorhinolaryngology, RIMS, Ranchi with the clinical features suggestive of this Rhino-orbital-cerebral mucor-mycosis. Proper written consent for the study was taken from the patient and his/her family members. All the 20 patients were subjected to imaging studies with Plain CT- Paranasal sinuses, orbit and brain and Gadolinium contrast MRI (T1W & T2W) of paranasal sinuses, orbit and brain, then they were evaluated.

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**Result**

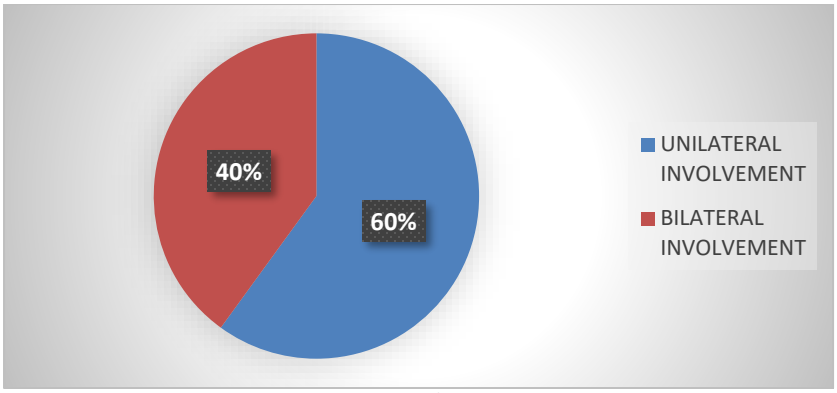
Paranasal Sinuses Involvement

The most common involved in our study was Maxillary sinus (18, 90%) and the least common was Frontal sinus (6, 30%). Bilateral sinus involvement (12, 60%) was more common than the unilateral (8,40%) involvement. TABLE 1 shows the sinuses involved in the mucor-mycosis and graph 1 shows the laterality of sinuses involved.

| Inclusion Criteria | Exclusion Criteria |
|---|---|
| • Age: 18 to 70 years<br>• Clinical feature suggestive of mucor-mycosis<br>• Patient with past H/O COVID-19 infection<br>• Rhino-orbital-cerebral form of mucor-mycosis<br>• Patient willing to give consent for study | • Age: <18yr and >70yr<br>• Other form of mucor-mycosis except rhino-orbital-cerebral form<br>• Patient with no past H/O COVID-19 infection<br>• Patient who refuses to give consent |

**Table 1:Paranasal Sinuses Involved**

| Sinuses Involved | Number | Percentage(%) |
|---|---|---|
| Maxillary | 18 | 90 |
| Ethmoid | 16 | 80 |
| Sphenoid | 16 | 80 |
| Frontal | 6 | 30 |
| Maxillary + Ethmoid | 3 | 15 |
| Maxillary + ethmoid + sphenoid Pansinusitis | 3 | 15 |
| | 9 | 45 |




CT and MRI Feature of Paranasal Sinuses

**Fig 1: Laterality of Sinuses Involvement**

In CT scan, the involved paranasal sinuses showed mucosal thickening (20,100%).In gadolinium contrast enhanced- MRI, all the paranasal sinuses were hypointense on T1W Fig, in T2W Fig signal characteristics were variable with most common being Hypointense (10, 50%) which is represented in Graph 2. Post- contrast enhancement pattern of paranasal sinuses are represented in the Fig 3.

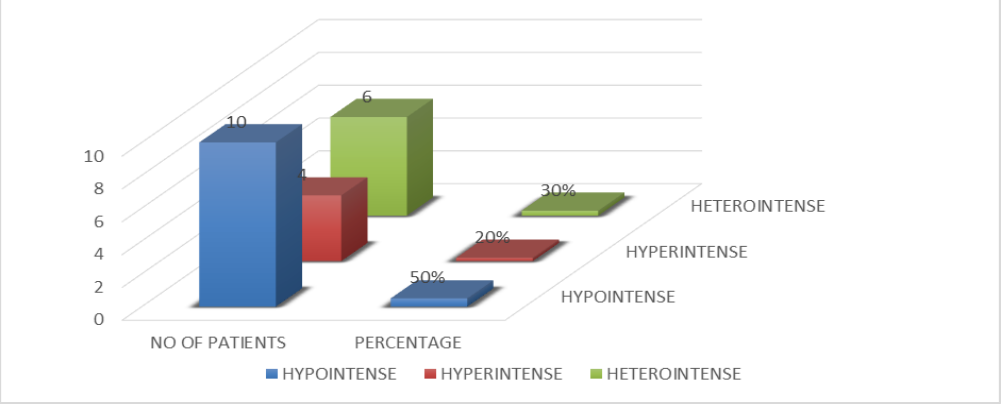



**Fig 2: Signal Characteristic of Paranasal Sinuses in T2W.**

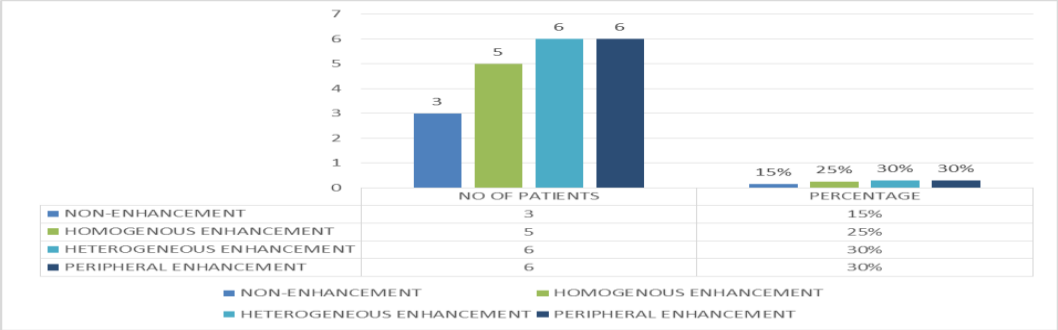



**Fig 3: Post-Contrast Enhancement Pattern of Paranasal Sinuses**

**Osseous Erosion in CT Scan**

Out of 20 patients,6(30%) patient had bony erosion. In these 6 patients, 3 (15%) patients had only medial wall of orbit erosion and one patient (5%) had only cribriform plate erosion while 2 (10%) of them had erosion of both.

**Extra- Sinus Involvement**

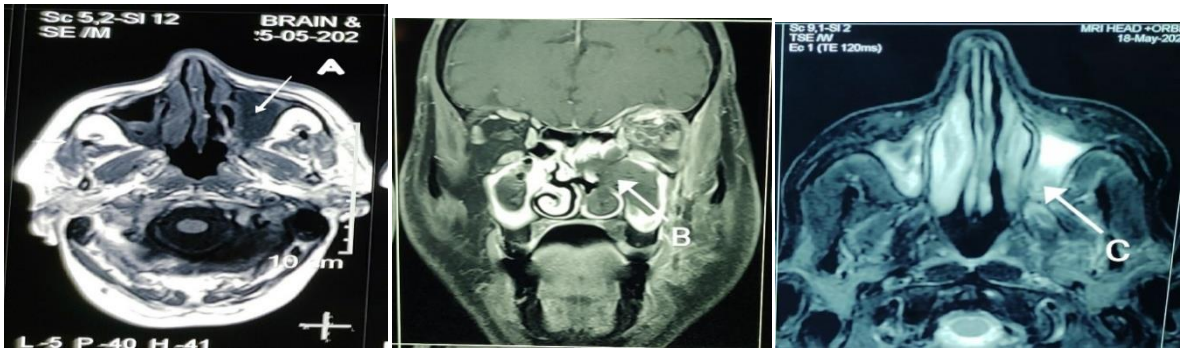
The other anatomical region to involve in rhino-orbital-cerebral mucor-mycosis are tabulated in the table 2. Most common extra-sinus site to get involved is Orbit (13, 65%) followed by infratemporal fossa (7, 35%).

**Table 2: Extra Sinus Sites Involvement**

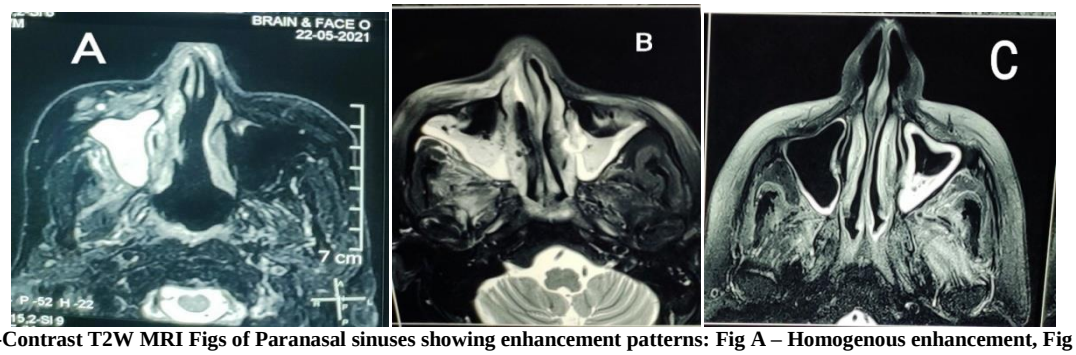
| Extra- Sinus Sites Involved | No of Patients (Percentage) |
|---|---|
| Orbit | 13 (65%) |
| Infratemporal fossa | 7 (35%) |
| Masticator space | 2 (10%) |
| Pterygopalatine fossa | 2 (10%) |
| Parapharyngeal space | 1 (5%) |
| Cavernous sinus thrombosis | 2 (10%) |
| Intracarotid artery encasement | 1 (5%) |
| BRAIN | |
| Frontal lobe | 6 (30%) |
| Temporal lobe | 1 (5%) |


**Fig A: Axial plain CT paranasal sinuses showing the mucosal thickening of the left maxillary sinus**


**Fig B: Coronal section of plain CT paranasal sinus shows bony erosion of cribriform plate and right medial orbital wall.**




**MRI T2W Fig of paranasal sinus showing the various signal intensity such as Hypointense (Fig A), Isointense (Fig B) and hyperintense (Fig C) pattern.**




**Post-Contrast T2W MRI Figs of Paranasal sinuses showing enhancement patterns: Fig A – Homogenous enhancement, Fig B – Heterogenous enhancement, Fig C – central non-enhancing with peripheral enhancement**

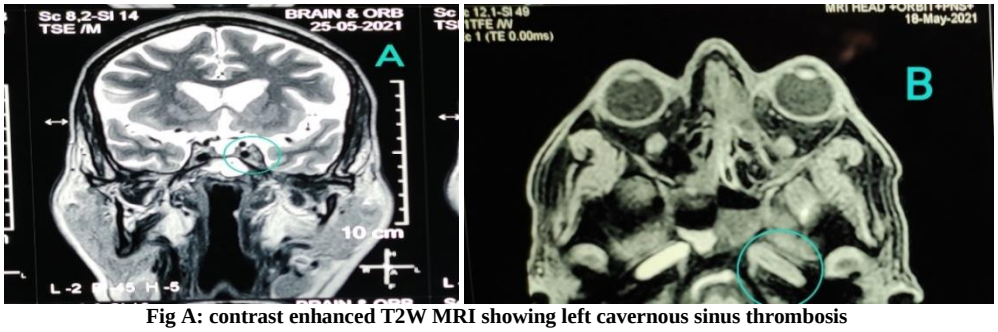



**Fig A: contrast enhanced T2W MRI showing left cavernous sinus thrombosis**
**Fig B: Contrast enhanced T1W MRI showing left non-enhancing lesion of internal carotid artery**

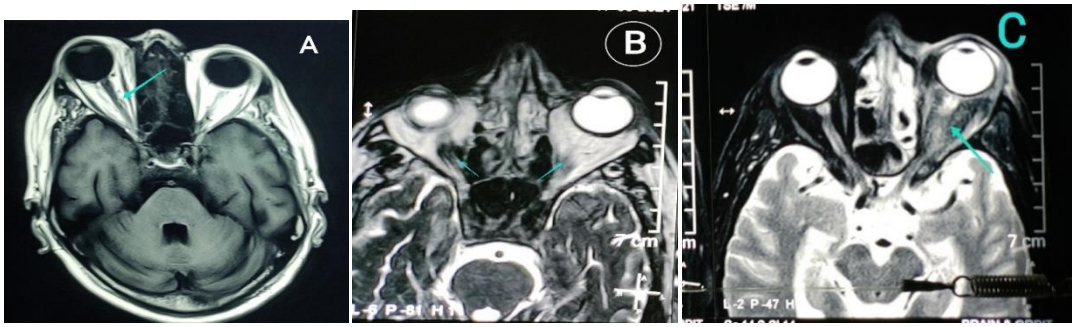



**Fig A: Contrast enhanced T1W MRI showing non-enhancement and thickening of right optic nerve.**
**Fig B: Contrast enhanced T2W MRI with iso to hypointense soft tissue intensity in both orbital apex.**
**Fig C: Contrast enhanced T2W MRI shows orbital fat stranding left**

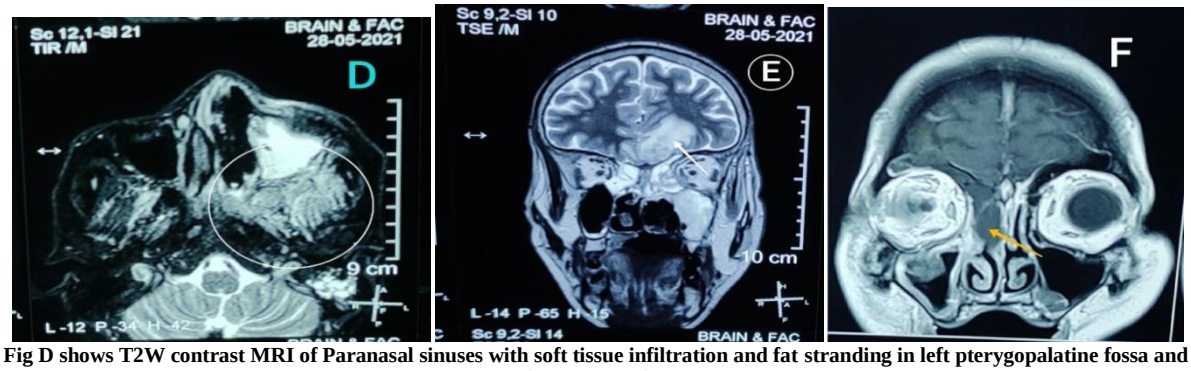



**Fig D shows T2W contrast MRI of Paranasal sinuses with soft tissue infiltration and fat stranding in left pterygopalatine fossa and infratemporal fossa**
**Fig E: T2W contrast enhanced MRI with hyperintense lesion in the frontal lobe left side**
**Fig F: T1W contrast enhanced MRI showing 'Black turbinate sign'**

**Discussion**

Mucor-mycosisis an emerging concern in COVID-19 patients who had corticosteroid therapy for severe infection [3], uncontrolled diabetes patient and other immunocompromised state [4]. It was first described by Paulltauf in 1885 [5], caused by the Mucorales species which includes Rhizopus,Mucor,Rhizomucor,Absidia, Cuming-hamella [6]. Inhalation of sporangiospores is the predominant route of spread [7] which found freely in environment. These spores colonize the nasal cavity and paranasal sinuses from where they spread rapidly to extra-sinuses site such as orbit and brain [8]. Survival rate for limited paranasal and nasal disease is about 50-80% [9] and mortality rate for brain involvement is 80% [10]. Due to its fatal course, early diagnosis and treatment predicts the outcome. For at risk patients CT scan is an effective tool for triage [11]. In our study CT feature of paranasal sinuses involvement is the mucosal thickening, which is a early manifestation of disease and also a non-specific finding that may resemble acute or chronic rhinosinusitis [12]. Mucosal thickening of sinusitis can be differentiated from mucor-mycosis by correlating CT finding with clinical picture [12].In our study most common sinus to get involved is Maxillary and least common to involve is Frontal sinus which was observed by Gamba JL et al [12].Breaks in the cortical bone surface is defined as a Bony erosion. It is a specific finding of an advanced invasive fungal disease [13].Middle brookes et al reported that 35% sensitivity and 100% specificity for bony erosion as marker of disease [14]. In our study we have observed that only 30% of patient had bony erosion due to the perineural and perivascular invasion nature of disease[15]. Due to which bone involvement will occur at the late stage of disease [16].In our study 100% and 50% of the patients had hypointenseparanasal sinus involvement in T1W and T2W Fig respectively. This reduced signal intensity is due to the iron, manganese and calcium present in the fungal element and its concretion which have the ability to disturb the magnetic field [16]. By this property we can differentiate fungal sinusitis from the bacterial sinusitis[17].In our study after administration of gadolinium contrast, variable enhancement pattern (homogenous, heterogenous, peripheral enhancement & non-enhancement) has been observed just as noted by Deigo A.Herrara et al [10] and Therakathu J et al [8].The most common extra-sinus site to get involved in our study is Orbit which was about 65% which was also observed by Minf N et al [18] and Therakathu et al [8]. The orbital involvement is mainly via the Nasolacrimal duct and medial orbital wall. The orbital involvement in MRI will be observed as fat stranding.The cavernous sinus and internal carotid artery involvement were noted in 10% and 5% of patients in our study in MRI.Mohindra et al stated that MRI can detect Vascular complication [19]. The hyphae proliferate along the internal elastic lamina and penetrate the endothelium, causing thrombosis, subsequently infarction and necrosis [20]. If untreated they enter into the cranium.In our study cerebral involvement was noted in 35% of patients with 30% of frontal and 5% of temporal lobe involvement.

**Conclusion**

Rhino-orbital-cerebral mucor-mycosis is an acute and fatal infection with higher mortality rate due to its rapidly spreading nature. To decrease the mortality rate, early diagnosis and intervention is needed. Gadolinium contrast enhancement MRI of paranasal sinus, orbit and brain can detect the early changes in optic nerve, paranasal sinuses and other extra-sinus involvement. It also helps to delineate about the extent of disease thereby surgical intervention can be done accordingly. Thus, MRI prevails over CT scan in all the aspects (perineural, base of skull, intracranial and intra-orbital changes) except for osseous involvement for which CT scan is needed.

**Conflict of Interest: Nil**
**Source of support:Nil**

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