

Mucormycosis: A Comparative Study Between Endoscopic And Radiological Features

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Abstract

Mucormycosis due to mucorales is common in immunocompromised patients affected with COVID-19. Rhino-orbito-cerebral mucormycosis (ROCM) was a new threat that emerged during the second wave of COVID 19. It is an invasive fungal disease with high rates of mortality and morbidity. Early diagnosis of mucormycosis requires high index of clinical suspicion due to its rapidly progressive nature. Gadolinium enhanced MRI is considered the gold standard in diagnosing mucormycosis. During the outbreak of mucormycosis we saw that surgical findings did not correlate with the radiological findings. Moreover, pre-operative and post-operative follow-up MRI posed a financial burden on the hospital. In this study we analyzed the correlation between radiological and endoscopic findings and also estimated the appropriate time during treatment when MRI is most relevant.

Keywords – mucormycosis, nasal endoscopy, magnetic resonance imaging,

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I. Introduction

The manifestations and complications of the COVID-19 pandemic had been far and wide Mucormycosis was one such complications manifested especially in immunocompromised individuals. This was due to angioinvasive spread by filamentous fungi of the Mucorales order of class Zygomycetes. ^[1]

The primary reason that appeared to facilitate mucorales spores to germinate in people with COVID-19 was an ideal environment of low oxygen (hypoxia), high glucose (proven diabetes, new-onset hyperglycemia, steroid-induced hyperglycemia), acidic medium (metabolic acidosis, diabetic ketoacidosis), high iron levels (increased ferritins) and decreased phagocytic activity of white blood cells due to immunosuppression (SARS-CoV-2 mediated, steroid-mediated or background comorbidities) coupled with several other shared risk factors including prolonged hospitalization with or without mechanical ventilators. ^[2]

MRI was helpful in assessing the extent of tissue and structural invasion by mucormycosis which required prompt and aggressive surgical and medical management. ^[3] Evaluation of ROCM (Rhino-orbito-cerebral mucormycosis) patients by MRI was required to assess the involvement of sinonasal structures, face, orbits, suprahyoid neck spaces, skull base, vascular structures, and intracranial compartment. ^[4,5] MRI was considered more sensitive than CT scan in demonstrating the extent of disease. ^[3,6] Nasal endoscopy done at the time of admission helped in confirming diagnosis and more-so in follow-up of the patients after surgical debridement.

During endoscopic debridement we saw that the radiological findings did not corroborate well with the intra-operative endoscopic findings. In this study we analysed the correlation between radiological and surgical findings and also tried to estimate an appropriate time for subjecting the patients for MRI.

II. Objectives of our study:

- To evaluate the involvement of structures through MRI and nasal endoscopy in patients of rhino-orbito-cerebral mucormycosis (ROCM) and compare them.
- To determine if any of the two diagnostic measures is more useful in surgical planning of the patient.

III. Methodology

This was a retrospective cohort study. Ethical approval was obtained from the Institutional Ethical Committee (ethical approval ref code 117th ECM II A-thesis/P13). Patients with histologically confirmed diagnosis of rhino-orbito-cerebral mucormycosis (ROCM) during the second wave of COVID-19 from the month of May to July 2022, were selected for the study. We further narrowed our selection by including only those patients where timing between MRI and surgical debridement was less than 72 hours. The case records of these

patients were retrospectively evaluated for relevant demographic, clinical and radiological data. Radiological grading of the paranasal sinus system as proposed by Lund and Mackay was used. This grading was extended to include structures other than nose and paranasal sinuses. Radiological scoring system was graded as: 0= no necrosis of the structure, 1= partial necrosis and 3= complete necrosis. Same grading was applied when structures were examined through nasal endoscope.

IV. Results and observations

A total of 161 patients were included in the study. There were 122 (75.8%) males and 39 (24.2%) females. 63 patients were present in the age group between 41 -50 years, followed by 48 patients in 51-60 years age group, 16 in 31-40 years age group and 34 patients were more than 60 years of age. Out 161 patients that we operated, 126 patients were diabetic, and 35 patients were non-diabetic. 20 patients had COVID during surgery and 141 were post COVID patients.

Individual structures of the nose and paranasal sinuses and extra sinus structures including face, orbit, infratemporal fossa, brain, cavernous sinus were compared on endoscopy and Gadolinium enhanced MRI.

Table 1 shows the frequency of involvement of structures as seen on endoscopy versus as seen on an MRI.

Table 1:

Sl.No	Structures involved	Endoscopy	MRI
1.	Maxillary sinus	155	180
2.	Anterior ethmoid	128	157
3.	Uncinate process	104	84
4.	Middle meatus	102	67
5.	Posterior ethmoid	83	91
6.	Middle turbinate	82	47
7.	Sphenoid	59	98
8.	Inferior turbinate	44	24
9.	Nasal septum	43	21
10.	Inferior meatus	38	21
11.	Superior turbinate	22	23
12.	Nasal floor	19	13
13.	Superior meatus	18	17

On nasal endoscopy 150 cases had no involvement of nasal floor while on MRI, the non-involvement was 153. This difference of 3 patients was actually partial involvement which was missed on MRI. As for the nasal septum, 142 patients showed no involvement on endoscopy and 152 on MRI. There was a discrepancy of 10 patients between endoscopy and MRI. Out of these 10, 9 patients had partial involvement and 1 had complete involvement, which was completely missed out on MRI. When it came to complete involvement, both endoscopy and MRI are comparable in sensitivity. On comparing the non-involvement of left inferior turbinate, a difference of 8 was observed between endoscopy and MRI, whereas in actuality out of these 8, 6 had partial involvement and 2 had complete involvement, again missed on MRI.

Similar observations were made for right inferior turbinates, bilateral middle and superior turbinates, uncinata processes and inferior and middle meatuses of both sides. Not much of a difference was noted for the superior meatuses.

The paranasal sinuses showed a different picture. MRI showed non-involvement of 62 maxillary sinuses of right side whereas intra-operatively 78 of these were not involved by disease process; these extra 16 sinuses were only filled with mucopurulent secretions alongwith mucosal thickening and occasional polypoidal changes. In addition to this, 3 maxillary sinuses which were actually completely involved (seen intra-operatively) were seen as partially involved on MRI. Same was the case with maxillary sinus of opposite side.

The anterior and posterior ethmoids showed a similar picture. Majority of the actual non-involvements were detected correctly on both MRI and endoscope. The ones that were missed on radiology were shown as partial involvement and, in some cases as complete involvement, which in reality did not stand true.

18 sphenoid sinuses of the right side were seen to be partially involved on MRI wherein on endoscopy these were not involved by the disease process at all; only fluid collection and polypoidal mucosa were seen. For structures like orbit, infratemporal fossa, pterygomaxillary fossa and face pre-op MRI was relied upon to assess degree of involvement and take surgical decisions. When complete involvement of structures on endoscopy and MRI was analyzed, a comparison could be drawn which showed the frequency to be almost equal (Table 2).

Table 2:

Sl.No	Structures involved	Endoscopy	MRI
1.	Nasal floor	3	3
2.	Nasal septum	12	9
3.	Inferior turbinate	17	11
4.	Inferior meatus	9	8
5.	Middle turbinate	46	29
6.	Middle meatus	55	40
7.	Superior turbinate	9	9
8.	Superior meatus	6	5
9.	Uncinate process	65	61
10.	Maxillary sinus	69	63
11.	Anterior ethmoid	45	47
12.	Posterior ethmoid	30	35
13.	Sphenoid	11	16

The structures beyond the nose and paranasal sinuses which could not be assessed endoscopically, were studied on MRI and were scored accordingly (Table 3). A checklist of red flag signs/symptoms signifying involvement of structures other than nose and paranasal sinuses, was prepared (Table 4). Here MRI was an absolute indication pre-operatively as well as post-operatively.

Table 3:

Sl. No	Structures	Partial involvement	Complete involvement
1.	Orbit	40	11
2.	Infratemporal fossa	6	2
3.	Pterygomaxillary fissure	4	1
4.	Face	4	1

Table 4: Red flag signs/symptoms warranting need for MRI

Altered mental status
Headache/ fever/ neck rigidity
Seizures/ hemiparesis
Blurring/ diminution of vision
Ophthalmoplegia
Peri-orbital edema
Proptosis/ptosis
Retro-orbital pain
Facial numbness
Cranial nerve deficits
Discharging sinus over face/ blackening over face

V. Discussion

Mucormycosis had always been present irrespective of COVID era but there was a sudden outburst of mucor cases during the second wave of COVID that led to the conception of this study. Our institutional experience during this epidemic has been translated into this paper. During the preparation of this manuscript extensive online literature search was done but it showed rarely any study correlating nasal endoscopy to MRI in cases of ROCM.

High index of suspicion, nasal endoscopy alongwith radiological investigations can lead to early detection of mucormycosis, thus limiting the morbidity.

At our centre, we advised MRI with contrast for every patient before surgical debridement. This was causing a huge financial loss as well as delay in surgical planning due to long waiting list of patients for MRI. This was a thought-provoking situation for us to decide the actual need and timing for MRI and thus lessen the pre-operative time and also the financial burden on the institution. Though imaging is vital for ROCM, patients

with early-onset ROCM can have normal CT and/or MRI images or may show non-specific abnormalities on MRI as it contains several artefacts that may mimic this pathology.⁴ Then we came up with a protocol where every patient suspected of ROCM was subjected to a detailed nasal endoscopy prior to surgery and also post-operative. Endoscopy detected even the slightest changes in the colour and texture of nasal mucosa which aided in planning surgical debridement without waiting for radiological images. A checklist of red flag signs/symptoms was prepared which could alert us about extranasal and paranasal extent of disease. Only these patients were subjected to Gad-enhanced MRI prior to the surgery; thus it helped us in restricting the waiting period for MRI. Post-surgery diagnostic nasal endoscopy was done regularly and noted in the patients's bed ticket. Slightest suspicion of appearance of any danger signs/symptoms was a reason for MRI. Patients who presented to us with any of the danger signs were advised both pre-operative and post-operative MRI for follow-up evaluation.

Increased burden of disease, high cost and long waiting time for MRI prompted us for this conceptualizing this project. Medical management of the patients included systemic amphotericin (50mg/kg/day upto maximum of 3g), intravenous antibiotics, glycemic control and other medications as per the need of the patients alongwith alkaline nasal douching in the post-operative period. Nasal endoscopy also assisted us in deciding the appropriate time to stop amphotericin apart from absence of any danger signs/symptoms and optimum general condition of the patient.

Early and accurate diagnosis of mucormycosis followed by prompt management and meticulous follow-up resulted in low rates of mortality and morbidity in our institution. Rapid progression of the disease can be prevented if patients present early and aggressive and extensive debridement can be avoided if proper evaluation and assessment is done at the time of presentation. Both endoscopy and MRI are an inevitable and unquestionable part of ROCM, the timing is what makes a difference.

VI. Conclusion

In conclusion we would like to comment that Gadolinium-enhanced MRI is still the gold standard radiological investigation to assess the spread of mucormycosis in head and neck region but Gad-enhanced MRI cannot be used routinely for follow-up of mucormycosis patients due to its financial burden on the institution and limited MRI machines leading to long-waiting list. We therefore recommend that if the red flag signs/symptoms are not evident then we should debride mucor and do the follow-up of patients based on nasal endoscopy alone. These patients can be subjected to MRI with contrast even at slightest suspicion of development of red flag signs/symptoms.

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References

- [1]. Petrikos G, Skiada A, Lortholary O, Roilides E, Walsh TJ, Kontoyiannis DP. Epidemiology and clinical manifestations of mucormycosis. *Clinical Infectious Diseases*. 2012 Feb;54(suppl_1):S23-34.
- [2]. Therakathu J, Prabhu S, Irodi A, Sudhakar SV, Yadav VK, Rupa V. Imaging features of rhinocerebral mucormycosis: a study of 43 patients. *The Egyptian Journal of Radiology and Nuclear Medicine*. 2018 Jun ;49(2):447-52.
- [3]. Sreshta K, Dave TV, Varma DR, Nair AG, Bothra N, Naik MN, Sistla SK. Magnetic resonance imaging in rhino-orbital-cerebral mucormycosis. *Indian J Ophthalmol*. 2021 Jul;69(7):1915-1927
- [4]. Dave TV, Nair AG, Hegde R, Vithalani N, Desai S, Adulkar N, Kamal S, Mittal R, Bradoo RA. Clinical presentations, management and outcomes of rhino-orbital-cerebral mucormycosis (ROCM) following COVID-19: a multi-centric study. *Ophthalmic plastic and reconstructive surgery*. 2021 Sep;37(5):488.
- [5]. Mazzai L, Anglani M, Giraudo C, Martucci M, Cester G, Causin F. Imaging features of rhinocerebral mucormycosis: from onset to vascular complications. *Acta Radiologica*. 2022 Feb;63(2):232-44.
- [6]. Hariprasath Prakash and others. A prospective multicenter study on mucormycosis in India: Epidemiology, diagnosis, and treatment, *Medical Mycology*, Volume 57, Issue 4, June 2019, Pages 395–402