

**How to Cite:**

Lalchandani, K., Syed, A., Lalchandani, V., Kotecha, H., & Patel, A. (2022). Evaluating predisposing factors and anaesthetic challenges in the emerging problem of mucormycosis in post COVID-19 patients: Retrospective cohort study. *International Journal of Health Sciences*, 6(S3), 8716–8726. <https://doi.org/10.53730/ijhs.v6nS3.8098>

## **Evaluating predisposing factors and anaesthetic challenges in the emerging problem of mucormycosis in post covid-19 patients: retrospective cohort study**

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**Abstract**--Background and Objectives: The epidemic of Mucormycosis came hovering like a tsunami in Covid- 19 recovered patients during second wave of the pandemic.. Mucormycosis is a rapidly progressive, angio-invasive, opportunistic fungal infection commonly caused by Rhizopus and mucor species. Mucormycosis can affect any organ system and pose several problems like uncontrolled diabetes, unstable hemodynamics, immunosuppression and difficult airway. Our study aimed to evaluate the predisposing factors and anaesthetic challenges encountered in Rhino-orbito-cerebral mucormycosis(ROCM) taken for surgical intervention under anaesthesia. Method: A retrospective, cohort study where we evaluated 100 covid-19 recovered patients who underwent surgical resection for ROCM under general anaesthesia. Hospital records of each patient were reviewed for demographic details, comorbid conditions, treatment modalities, covid associated organ damage, hemodynamics, surgical procedures, anaesthetic technique, and mortality. Results: Demographic data showed a male preponderance with 67 males and 33 females in the age group of 25-74yrs. 68

patients were ASA grade 3, 31 patients were ASA grade 4 and 1 patient was ASA grade 5. Comorbid conditions showed 78 patients had DM, 8 patients had hypertension, while 14 had both. Out of these, 12 patients had other comorbidities also. Bougie guided intubation was done using McCoy blade in 26 pts, videolaryngoscope was used in 59 pts. 3 pts required tracheostomy. 7 pts with delayed recovery required postop ventilator therapy. 3 patients did not survive. Conclusion: Early recognition of predisposing factors in a setting of high suspicion, optimizing comorbidities, judicious use of corticosteroids, antifungal and antibiotics combined with surgical resection can improve the outcome of ROCM.

**Keywords**---rhino-orbito-cerebral mucormycosis, diabetes mellitus, anaesthetic challenges, difficult airway.

## Introduction

As India was recuperating from second wave of Covid-19 Pandemic, our health system was awestruck by another epidemic which appeared like a Tsunami in covid-19 recovered patients – horror of deadly Mucormycosis which kept various health departments on toes. It was like “falling from frying pan to fire.”<sup>(1)</sup> Mucormycosis is a rapidly progressive, angio-invasive, opportunistic fungal infection mainly caused by *Rhizopus* and *Mucor* species. Mucormycosis and covid-19 form an evil combination which carries mortality rates as high as 40-80%.<sup>(1,2)</sup> Since April 2021, India has seen an alarming rise in the number of Covid-19 associated Mucormycosis.<sup>(3)</sup> Covid-19 induced immunosuppression, use of immunosuppressants including steroids (methylprednisolone and dexamethasone in high doses), iron overload, tocilizumab; preexisting comorbidities like Diabetes Mellitus, hypertension, ischemic heart disease, lung pathology, renal disease make them vulnerable to the deadly fungus.<sup>(4)</sup> Diabetes Mellitus found to be the most important risk factor.<sup>(3)</sup> As India has become diabetic capital of the world, this fungus hit our Indian population the hardest. Harsh truth is that majority of Indian Diabetic population are unaware of their diabetic status till landing up in hospital with complications.

Although mucormycosis affects any organ of the body, we mainly encountered rhino-orbito-cerebral mucormycosis (ROCM) in our institute. The patients of ROCM present with symptoms of sinusitis, stuffy nose, tooth ache, facial swelling, vision disturbances, ptosis, proptosis and worsening headache. The diagnosis is mainly based on medical history, clinical features, laboratory, radiological and histopathological report.<sup>(5)</sup> Treatment modalities of mucormycosis include medical management of underlying comorbid conditions, antifungal drugs and antibiotics; combined with surgical management<sup>(5)</sup> Amphotericin B is the only systemic antifungal drug proven effective against mucormycosis but has side effects like nephrotoxicity, hypokalemia and hypomagnesemia. Liposomal amphotericin has low systemic toxicity but unfortunately it is not available all the time.<sup>(6)</sup> Vascular thrombosis caused by mucormycosis prevents the drugs to systemically reach the infected tissue.

Hence Surgical debridement is the definitive therapy and can be lifesaving, as it removes the necrotic tissue and allows the drug to reach the infected site for action. <sup>(6)</sup> Surgical management includes functional endoscopic sinus surgery (FESS) for debridement, drainage of paranasal sinuses, surgical exenteration, maxillectomy and even craniectomy in cerebral involvement. Surgery in these patients is a challenge for anaesthesiologists due to uncontrolled diabetes, hemodynamic instability, post covid syndrome, lung pathology, anticoagulants, psychosocial factors, anticipated difficult airway, renal dysfunction and electrolyte imbalance, use of Amphotericin B with its side effects. Preoperative optimization of conditions such as lung infection, dehydration, malnutrition, glycemic control, dialysis, modifying anticoagulant therapy should be done as far as possible along with blood investigations and radiological imaging. Counselling of patient and relatives play an important role to reduce psychosocial stress.

Difficult airway is anticipated in these patients due to restricted mouth opening, painful jaw movement, supraglottic and glottis oedema, presence of mucor debris in oral and nasal cavity. Proper operation theatre preparation and difficult airway cart is required to combat difficult airway situation in these patients. <sup>(7)</sup> Due to rapid progressive and fulminant nature of the disease, majority of the patients need to be taken for surgery on emergency basis adding to our challenges as there is little time for optimization. Main purpose of our study was to evaluate predisposing factors and anaesthetic challenges in covid-19 associated Mucormycosis of ROCM type who underwent surgical intervention under general anaesthesia. Our study will enhance our knowledge towards this devastating problem and this knowledge can be implemented further to improve its outcome.

### **Materials and Methods**

After obtaining approval from Institutional Ethical committee (No.IECBHR/88-2021) for this retrospective cohort study, medical records of 100 patients that underwent surgical resection for rhino-orbito-cerebral mucormycosis (ROCM) under general anaesthesia at Sir Sayajirao General Hospital (SSGH), Baroda (Gujarat, India) between April 2021 to June 2021, were obtained from computerized data of the hospital and were reviewed. Adult patients in the age group of 25-74yrs, who were covid-19 positive in last 45 days and admitted in ENT department of SSGH for treatment of ROCM were included. Patients with pre-existing renal disease, oropharyngeal malignancy, chronic tobacco chewer and neurological disorders were excluded. All patients underwent thorough preoperative assessment with respect to their comorbidities, symptoms and clinical features of mucormycosis and risk stratification was done according to ASA (American Society of Anaesthesiologists) classification. Patients were evaluated for drugs like Steroids, IL6 inhibitor or other immunosuppressants, antifungals like Amphotericin B, antibiotics, oxygen therapy in the form of nasal prongs, facemask, NRBM, HFNO, BIPAP or IPPV. Difficulty in airway was assessed by mallampatti grading, mouth opening, neck mobility. Baseline blood investigations included – WBC count, RBS, HbA1C, coagulation profile, renal and liver function tests; others such as Chest xray, ECG, 2D Echocardiography. CTscan of paranasal sinuses and MRI brain done to assess extent of the disease.

## **Anaesthetic Management**

### **Monitoring**

Included heart rate (HR), noninvasive blood pressure (NIBP), electrocardiogram (ECG), peripheral oxygen saturation (SpO<sub>2</sub>), ETCO<sub>2</sub>, temperature and urine output. RBS and ABG were sent intraoperatively at intervals as per the patients preoperative and intraoperative status and duration of surgery. Difficult airway cart was kept ready. It included McCoy laryngoscope, bougie and videolaryngoscope also. Tracheostomy tray was kept ready too.

### **Premedication**

A Premix I.V. preparation of Paracetamol 1gm, Inj.MgSo<sub>4</sub> 1gm, Inj. Lignocaine (1mg/kg) and fentanyl (1 mcg/kg) given 30 minutes before induction in preoperative room with monitoring.

### **Induction**

After 5-min preoxygenation (100% O<sub>2</sub>, 10 L/min) using closed circuit through Drager Fabius Plus anaesthesia workstation, anaesthesia was induced with intravenous propofol (1.5–2 mg/kg), followed by ventilatory test, and then intravenous rocuronium (0.6 mg/kg). Intubation was done with appropriate size cuffed oral PVC endotracheal tube using either conventional, McCoy or Video laryngoscope according to airway difficulty. Endotracheal tube placement was confirmed with bilateral auscultation for equal air entry and capnography. Oropharyngeal packing was done using sterile gauze.

### **Maintenance**

Patients were ventilated at a frequency of 12-14 breaths per min with a tidal volume 6-8 mL/kg to maintain EtCO<sub>2</sub> value within a range of 35- 45 mmHg. Anaesthesia was maintained with oxygen and air (ratio of 40:60), Desflurane/sevoflurane and Inj Atracurium as muscle relaxant intermittently. At the end of the surgery, patients were ventilated with 100% oxygen. In uneventful cases, patients were reversed using atropine (0.01–0.02mg/kg) and neostigmine (0.05 mg/kg). Patients who achieved adequate spontaneous respiration (respiratory rate > 12/min, tidal volume > 5 mL/kg), SpO<sub>2</sub> levels > 95% and good response to verbal commands were extubated and transferred to post anaesthesia care unit for further observation. Hemodynamically unstable patients and those who showed insufficient respiratory efforts were transferred to ICU without extubation and kept on ventilator. Duration of ICU stay was defined as time between admission to and discharge from ICU. In-hospital mortality was considered when death occurred during hospital stay. Patient data regarding length of hospital stay and mortality rate were obtained from computerized hospital records. Statistical Analysis Data was done using SPSS for Windows version 25. Quantitative variables were expressed as median and minimum-maximum values. Categorical variables were expressed as frequencies and percentages.

## Results

Retrospective cohort study entitled “Evaluating predisposing factors and anaesthetic challenges in the emerging problem of mucormycosis in post covid-19 patients”, was carried out in tertiary care centre of SSG hospital from 1<sup>st</sup> April 2021 to 30<sup>TH</sup> June 2021

Table 1  
Demographic Data

Demographic Data	No. of Patients (total 100)
Age(years)	25-74 years (48 median age)
M/F	67:33
Weight	45-80 kg (60)
ASA grading III/IV/V	68/31/01
Duration of surgery	2 to 4 hours
Mallampatti grading I/II/III/IV	0/21/68/11
Surgical course – debridement only / debridement + orbital exenteration / dental extraction/ maxillectomy	63/14/15/08

Table 2  
Predisposing factors and comorbidities

Variables	No. of patients
Covid positive in the past	100
Comorbidities DM/HTN/DM+HTN/OTHERS (CKD, IHD, anticoagulant therapy)	88/12/14/12
O2 therapy Nil/NP/NRBM/BIPAP/IPPV	26/24/29/18/03
Immunosuppressants therapy Not given/MPSS/Tocilizumab	26/74/11
Antifungal medication (Amphotericin B)	100

Table 3  
Perioperative events

Peri-operative events	Patient details
Intubation: conventional Mc coy laryngoscope	12 26

Video laryngoscope	59
Tracheostomy	03
Hypotension	05
Hypertension	08
Hypoglycemia	02
Hyperglycemia	38
Ketoacidosis	05
Delayed recovery and ICU care	07
postopVentilatory support	04
Hemodialysis	04
Mortality	03

Table 1 shows demographic data. We have studied total 100 patients retrospectively, between the age group of 25 to 74 years with median age of 48 years. 67 patients were Male and 33 patients female pointing to male preponderance. Median body weight was 60 kg (range, 45-80) kg. All patients were under high-risk category: 68 patients ASA grade III, 31 patients ASA IV and 1 patient ASA grade V. In our study due to extensive rhino orbito cerebral involvement, difficult intubation was anticipated in most patients. Out of 100, Conventional intubation was done using Macintosh blade in only 12 patients, McCoy laryngoscope with bougie guided intubation in 26 patients, 21 patients had Mallampatti grading (MPG) II, 68 had MPG III, 11 patients had MPG IV, which prompted us to use videolaryngoscope for endotracheal intubation in 59 patients. 3 patients required Tracheostomy. Surgical intervention done: in all 100 patients debridement done; apart from that, exenteration was done in 14 maxillectomy done in 8 and dental extraction done in 15 patients.

Total duration of surgery was 2–4 Hrs. Table 2 shows preoperative variables. In our study we noted that out of 100 patients 78 patients had only DM, 08 patients were only Hypertensive while 14 patients had both DM and HT. Out of these, 12 patients had other comorbidities like renal involvement, hyper/hypokalemia, other electrolyte abnormalities. Table 3 shows the perioperative events. We observed intraoperative hypotension in 5 patients. 08 patients developed hypertension (in preexisting hypertensive patients), 2 patients had hypoglycemia and 38 patients developed hyperglycemia immediate postoperatively. 4 patients developed renal failure in postoperative period, who required Hemodialysis. 7 patients had delayed recovery out of these 4 patients required ventilatory support for 24 hours and then extubated and were observed in ICU. While 3 patients could not be revived due to extensive disease with lung involvement.

## Discussion

“Fungi are the interface between life and death” – Paul Stamets. Mucormycosis is a rapidly progressive, angio-invasive, potentially lethal, opportunistic fungal infection caused by *Rhizopus* and *Mucor* species. <sup>(8)</sup> India saw a tsunami of mucormycosis patients during recovery phase of second wave of covid-19. These patients presented with sudden onset of rapidly progressive symptoms of the fungal invasion. Proposed hypothesis for the sudden surge of mucormycosis in

covid-19 patients: hypoxia; preexisting diabetes, new-onset diabetes ( may be steroid-induced), diabetic ketoacidosis, metabolic acidosis due to dehydration and sepsis; malnutrition; high-iron (ferritin) levels favoured by acidosis; lymphopenia, neutropenia; decreased phagocytic activity of white blood cells due to immunosuppression. <sup>(4,8)</sup> Poor glycaemic control in the setting of covid 19 possibly resulted from cytokine storm and direct injury to the pancreatic beta cells in the backdrop of limited access to diabetes care during lockdown. Tight control of blood sugar level among diabetic patients is required to help in reducing incidence of ROCM. <sup>(4)</sup>

World health organization (WHO) COVID- 19 guidelines distinctly cautions against usage of Corticosteroids in COVID- 19 patients not requiring oxygen (absence of hypoxia, SPO2 > 95% on room air). Regardless of this, rampant use of steroids even in mild COVID- 19 occurred in India in a bid to save lives. The reason could be the sudden surge of cases during second COVID- 19 wave leading to panic among medical practitioners, no time for triaging patients in overcrowded clinics, non- evidence based clinical practice, easy availability of steroids, and not able to keep track of patients taking steroids. Post COVID-19 sepsis is another predisposing factor which leads to impairment of innate immune response, ciliary dysfunction, cytokine storm, thrombo-inflammatory phenomenon, microvascular thrombosis; ultimately causing immune fatigue thereby providing favourable conditions for fungal and/ or even bacterial invasion in post covid patients.<sup>(9)</sup> Corticosteroids and anti-IL-6-directed strategies in these highly susceptible hosts along with high fungal spore counts in the environment also set up the ideal condition for the growth of mould. <sup>(8,10)</sup> Red flag signs of ROCM have been introduced in the national guidelines for COVID-19 management which if recognized in time can facilitate early diagnosis to improve outcome in these patients.

**Red Flags** of ROCM in the Setting of COVID-19 include <sup>(8)</sup>. Nasal stuffiness, Foul smell, Epistaxis, Nasal discharge - mucoid, purulent, blood-tinged or black, inflammation, Eyelid, periocular or facial edema, discoloration, fever. Regional pain – orbit, paranasal sinus or dental pain, Facial pain, Worsening headache, Proptosis, Sudden loss of vision, Sudden ptosis, Ocular motility restriction, diplopia. Facial paresthesia, Facial palsy, altered sensorium, paralysis, focal seizures. The median age of patients in our study was 48 years (25 to 74 years) with male preponderance of 67%. Factors cited for the biased male:female ratio are greater exposure to fungal spores due to prolonged outdoor activity in males and possible defensive role of oestrogens in females. In our study, 78 patients had only DM and 14 patients had both DM and HT, which points to DM to be major comorbidity. Our findings are in consonance with the study of Ameet Dravid, Reema Kashiva et al., who also reported 90% of ROCM patients suffering from Diabetes Mellitus. <sup>(9)</sup> In our study, 08 patients were only Hypertensive. 05 patients suffered from DKA. 12 patients had other comorbidities like CRF, hyper/hypokalemia and other electrolyte abnormalities, post covid syndrome and ischemic heart disease.

Systemic corticosteroids are recommended in moderate and severe COVID-19 cases. <sup>(5)</sup> In our study 79 patients received systemic corticosteroids in the form of methylprednisolone or dexamethasone, [19](#) that might have caused

immunocompromised state predisposing to mucormycosis. 21 cases, however, never received steroids but were diabetic. Thus, steroids solely may not have contributed to the causation of ROCM. Further, Tocilizumab which is an anti IL6 receptor, was administered in 17 patients. Prolonged use of corticosteroid in high doses may also cause adrenal suppression leading to perioperative hypotension. Fluid replacement and/or inotropic support usually take care of hypotension. Blood and blood products may be required in prolonged, extensive surgeries and if patient is anaemic. Perioperative central venous cannulation should be considered in these patients. Airway epithelial damage in COVID-19 patients due to oxygen delivery devices, prolonged use of humidifiers, repeated swab tests and steam inhalation injuries are other theories postulated to favour fungus invasion of nasal tissues <sup>(4,5)</sup> In our cohort, out of 100 patients, 53 patients received oxygen therapy, 18 patients were on noninvasive ventilation, 03 patients on invasive ventilation. Ocular involvement was commonly manifested by ptosis and dimness or loss of vision and exenteration was required to save the life. <sup>(4)</sup> In our study, 14 patients underwent exenteration. 63 patients underwent only debridement (FESS), whereas dental extraction and maxillectomy done along with debridement in 15 and 8 patients respectively. Presence of diabetic ketoacidosis ( $p = .011$ ) combined with cerebral involvement ( $p = .0004$ ) were associated. with increased mortality on Relative risk analysis

### **Anaesthetic challenges and management of post-COVID mucormycosis**

These patients pose several challenges: The surgical procedures usually involve debridement, functional endoscopic sinus surgery, maxillectomy, mandibulectomy, exenteration, enucleation, palatal debridement, craniotomy, etc., often done under general anaesthesia.<sup>(5)</sup>

### **Preoperative preparation and optimisation of the underlying condition was done to improve outcome in these patients**

Our patients scheduled for mucormycosis surgery were thoroughly screened for effects of mucormycosis on airway, multi-organ effects of COVID and DM, and systemic effects of AmB administration. Complete biochemical work-up of renal functions, electrolytes and coagulation profile were done.

### **Airway management**

Majority of patients had difficult airway because of epiglottitis, sub- and supra-glottic oedema, restricted mouth opening due to jaw erosion and pain, palatal ulcers which bleed on touch, palatal perforations, crusts in the nose, oroantral fistulas and DM-induced joint stiffness. <sup>(7)</sup> In our study out of 100 patients 21 patients have Mallampatti grade II, 68 grade III and 11 patients had grade IV. 5 patients had unanticipated difficult intubation. Thus, we considered all patients to have difficult intubation. So, in 26 patients intubation was carried out using McCoy laryngoscope, In 59 patients VLS (videolaryngoscope) was used and 3 patients required tracheostomy. Maintenance of an adequate mean arterial pressure, cardiac output and normovolaemia while concomitantly avoiding further renal insults is of paramount importance. Electrolyte disturbances such



as hypokalaemia and hypomagnesemia due to AmB can interfere with neuromuscular blocking drugs, leading to problems such as delayed recovery when administering neuromuscular blockers such as succinylcholine, the possibility of hypokalaemia due to AmB and hyperkalaemia due to critical illness-induced myopathy should be kept in mind. <sup>(5)</sup> Considering these points Serum potassium and blood glucose levels were closely monitored peri-operatively.

We observed intraoperative hypotension in 5 patients who were treated with IV fluids and Ionotropes, E.Karaaslan also reported difficult airway and hemodynamic instability in their study. 08 patients in our study developed hypertention intraoperatively (in preexisting hypertensive patients), who were treated with nitroglycerine drip, 2 patients had hypoglycemia and 38 patients developed hyperglycemia immediate postoperatively. 4 patients developed renal failure in postoperative period, who required Hemodialysis. 7 patients had delayed recovery out of which 4 patients required ventilatory support for 24 hours and then extubated and were observed in ICU. While 3 patients could not be revived due to extensive disease with lung involvement. Limitations: This is only a retrospective cohort study which does not have any control group (COVID- 19 patients without mucormycosis) We couldn't establish the link between risk factors like use of industrial oxygen, contaminated nebulizer fluids or inline humidifier tubing used in ventilator circuits and contaminated oxygen delivery systems with increased incidence of ROCM. Since this was a single centric study with a small sample size, a multicentric study with a larger sample size will give more incite to the causative factors of mucormycosis. Despite these limitations, this retrospective cohort study will add to the growing body of literature on clinical features, predisposing factors, anaesthetic challenges and management strategies, to improve the outcomes of COVID- 19 associated mucormycosis (ROCM).

## **Conclusion**

Covid associated rhino-orbito- cerebral mucormycosis is a rapidly progressive disease which is often fatal if left untreated. Early recognition of clinical features and timely diagnosis is required in order to start treatment, both medical and surgical at the earliest thereby improving the outcome in these patients. Timely recognition and meticulous management in the form of medical treatment combined with surgical intervention requires multidisciplinary teamwork involving various specialities which helps to decrease morbidity and mortality in these patients. To give anaesthesia in these patients is a big challenge. Thorough clinical evaluation of these patients along with preoperative optimisation helped us to overcome the perioperative problems. Needless to say that among anaesthetic challenges Airway management is of prime importance as these patients require general anaesthesia with endotracheal intubation, which was taken care of by using Mccoy laryngoscope and VLS, as difficult airway is anticipated.

## References

1. Rajeev Soman<sup>1</sup>, Ayesha Sunavala<sup>2</sup> Post COVID-19 Mucormycosis - from the Frying Pan into the Fire Journal of the Association of Physicians of India January 2021 volume 69
2. E Karaaslan Anesthetic management of rhinoorbitocerebral mucormycosis; Focus on challenges J. Mycol Med. 2019 Sep;29(3):219-222.
3. Awadhesh Kumar Singh <sup>a</sup>Ritu Singh<sup>a</sup> Shashank R. Joshi<sup>b</sup> Anoop Misra<sup>cde</sup> : Mucormycosis in COVID-19: A systematic review of cases reported worldwide and in India Diabetes & Metabolic Syndrome: Clinical Research & Reviews , Volume 15, Issue 4, July–August 2021, 102146
4. Ritu Arora,<sup>1</sup> Ruchi Goel,<sup>1</sup> Samreen Khanam,<sup>1</sup> et al. Rhino-Orbito-Cerebral-Mucormycosis During the COVID-19 Second wave in 2021 – A Preliminary Report from a Single Hospital Clin Ophthalmol. 2021; 15: 3505–3514.
5. Naveen Malhotra, Sukhminder Jit Singh Bajwa,<sup>1</sup> Muralidhar Joshi,<sup>2</sup> Lalit Mehdiratta,<sup>3</sup> and Madhuri Kurdi<sup>4</sup> :Second wave of COVID-19 pandemic and the surge of mucormycosis: Lessons learnt and future preparedness: Indian Society of Anaesthesiologists (ISA National) Advisory and Position Statement IJA Indian J Anaesth. 2021 Jun; 65(6): 427–433.
6. Atul Vyas, Isha Shah et al : Anaesthetic considerations for post covid mucormycosis surgery: Focus on challenges- A retrospective study International journal of scientific research volume 10 issue 10 54 -56 October 2021
7. Code Mucor: Guidelines for the Diagnosis, Staging and Management of Rhino-Orbito-Cerebral Mucormycosis in the Setting of COVID-19 June 2021 Indian Journal of Ophthalmology Volume 69 Issue 6 1361-1364
8. Prenissl J, Jaacks LM, Mohan V, et al. Variation in health system performance for managing diabetes among states in India: a cross-sectional study of individuals aged 15 to 49 years. BMC Med 2019; 17:92.
9. Ameet Dravid, Reema Kashiva,<sup>2</sup> Zafer Khan,<sup>3</sup> Balasaheb Bande<sup>3</sup> et al.: Epidemiology, clinical presentation and management of COVID-19 associated mucormycosis: A single centre experience from Pune, Western India. Mycoses (Wylie online library) Feb 2022 volume 65, issue 5, page no. 526-540
10. Prakash H, Chakrabarti A. Global Epidemiology of Mucormycosis. J Fungi (Basel) 2019; 5:26.
11. Chakrabarti A, Kaur H, Savio J, et al. Epidemiology and clinical outcomes of invasive mould infections in Indian intensive care units (FISF study). J Crit Care 2019; 51:64-70.
12. Ibrahim AS, Spellberg B, Walsh TJ, et al Pathogenesis of mucormycosis..Clin Infect Dis 2012; 54 (Suppl 1):S16-22.
13. Kathy H, Tony A, Matthew J, et al. A case of invasive pulmonary mucormycosis resulting from short courses of corticosteroids in a well-controlled diabetic patient. Medical Mycology Case Reports 2020; 29:22-24
14. Prasad K. Kulkarni, Narasimha B. Reddy, B. Shrinivas<sup>1</sup>, Vinita V. Takkalki. Anesthetic considerations in the management of mucormycosis: International journal of Medicine and public health.vol.5issue4, Oct-Dec2015
15. COVID-19 associated mucormycosis: Staging and management recommendations (Report of a multi-disciplinary expert committee) Hardeep Singh Malhotra , Prashant Gupta et al. Journal of Oral Biology and

16. Suhas Ashok Hooli, Vaijayanti Nitin Gadre, Sunita Bage,<sup>1</sup> and Manoj Dnyanba Gilvarkar: The aftermath of COVID-19 pandemic: Rhino-orbital mucormycosis Indian J Anaesth. 2021 Jul; 65(7): 548–553.



Source of funding: Nil

Conflict of interest: No conflict of interest

Acknowledgement: We are thankful to Dr. R.G Aiyer, Superintendent and head, department of ENT, SSG hospital Vadodara for his support. I am also thankful to our HOD Dr. Swati Bhatt for her constant guidance.