



Emerging Syndemic: Black Fungus—A Post-COVID-19 Mucormycosis

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Novel coronavirus has created a havoc in India; about 30 million cases have been reported and 0.4 million deaths are recorded till now due to coronavirus disease 2019 (COVID-19). But nowadays, some patients of COVID-19 in India are battling a very rare but fatal disease, that is, mucormycosis or “black fungus” disease. The consciousness about the black fungus disease in many people of India is due to its rising cases of COVID-19-associated mucormycosis (CAM) mostly among the people who have recovered from COVID-19. Following recovery from COVID-19, thousands of cases of several complications of patients regarding CAM are reported especially during the second wave of COVID-19 in India. Mucormycosis or “black fungus” is a rare disease caused by fungi belonging to the order Mucorales. It is a disease observed following infection with the novel coronavirus in India and has already taken the form of a pandemic in many states.^{1,2} Therefore, scientists have chosen to name the disease as a syndemic since this is synergistically created with the pandemic. The ubiquitous molds of mucormycosis having a worldwide dispersal, including the *Rhizopus*, *Apophysomyces*, *Mucor*, and *Lichtheimia* species, are found in plants, soil, decaying fruits and vegetables, and even in air. If contact occurs with airborne spore, then it germinates into hyphae and is regarded a very rare occurrence. This preferentially takes place inside the buccal cavity. After germination, it can invade the neighboring tissue and blood vessels that results in characteristic hemorrhage followed by black color development. The visualization of these dark necrotic tissues on skin and blood vessels of the affected person is termed as black fungus disease. Till now five major forms of mucormycosis have been identified, for example, rhinocerebral (44–49%), cutaneous (10–16%), pulmonary (10–11%), disseminated (6–11.6%), and gastrointestinal (2–11%) forms. Among

these, the most common rhinocerebral form usually occurs in immunocompromised individuals. It exhibited a “pattern paranasal infection” with a porch into the oral cavity often. It is a quickly emerging angioinvasive infection, with rhino-orbital-cerebral and pulmonary manifestations. According to the Indian government, there are over 11,700 reported cases and over 126 casualties as of May 2021.³ There is a surge in terms of infection rates. Though mucormycosis is generally regarded as harmless to an immunocompetent host, it may be fatal in some cases in its combination form with factors like indiscriminate use of steroids or other immunosuppressants, even in subjects presenting with mild symptoms of COVID-19. Immunocompromised patients like people with hematological malignancies, damaged mucosal layer, uncontrolled diabetes, ketoacidosis, and viral induced lymphopenia are the prime victims of this deadly fungus.⁴ It is a fatal disease if unnoticed as it is invasive to blood vessels, distant organs, nose, mouth, eyes, sinus, and even brain. If untreated, the infection usually develops speedily, and leads to death within a few days of contamination.

Till the time this disease of public health importance remains under-explored along with the scarcity of literature available with regard to various perspectives on mucormycosis, medical professionals remain devoid of all the necessary information collated together for tackling the syndemic of mucormycosis. Mortality rate is as high as 80% for this fatal disease.⁵ General diagnosis relies on tissue culture and histology that are very time consuming as there are no serological tests for early diagnosis. Thus, after recovery from COVID-19, patients should maintain a tough vigilance in their health and if they find either of the following symptoms, they should seek medical help as

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soon as possible. Some symptoms of black fungus disease are as follows:

- a. Face swelling
- b. Eye swelling
- c. Unusual bloody or black-brown discharge from the nose
- d. Pain and numbness
- e. Nasal or sinus congestion
- f. Black lesions on nasal bridge or upper inside of the mouth

It is the need of the hour to prevent this syndemic to spread in patients by limiting the usage of steroids (glucocorticoid mainly) to people with mild COVID-19 infections. Beside this, only medical grade oxygen should be used for all the patients after proper sanitization of the cylinders. Wearing a mask post-COVID-19 can minimize the infection of CAM, but reuse of the same mask for 2 to 3 weeks can increase the chances of infection of CAM. As previously stated, one combination factor of CAM is ketoacidosis; it can enhance proton-mediated displacement of ferric form and accumulate serum-free irons that in turn impair phagocytic activity which aids in the growth of fungal pathogen.⁶ Similarly, the extensive use of iron-laden multivitamins as “immunity boosters” might lead to augmented free-iron levels as well. Some other precautions should be taken by all the medical professionals to beat the mucormycosis are as follows:

- i. Proper decontamination of hospital environment. Fungal pathogens can live up to hours to month in hospital beds, bed bars, table, tap, etc.
- ii. Use of disposable oxygen humidifiers and clean distilled water in humidifiers and in oxygen concentrators.
- iii. Limit the use of iron and zinc supplements for the management of COVID-19.
- iv. Avoid the use of broad-spectrum antibiotics unless required.
- v. Maintain the personal hygiene strictly even after recovery from COVID-19.
- vi. Avoid staying in a damp environment.

- vii. Avoid the overuse of steam inhalation and nonhumidified oxygen. Steam inhalation may result in destruction of the mucous layer that may lead to easy penetration of Mucorales.
- viii. Maintain strict metabolic control including the blood sugar levels.
- ix. Educate the patients suffering from COVID-19 about the early signs and symptoms of mucormycosis during hospital discharge.
- x. Use the amphotericin B (antifungal drug) to treat mucormycosis followed by surgical debridement.

Presently the incidence of CAM is as high as 70% in India than global average. Therefore, we must be very cautious about the secondary fungal infections in COVID-19 patients. This is the time to bring awareness of fungal diseases in India as India needs better consensus for fungal diseases.

Conflict of Interest

None declared.

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