

COVID-19: Recent Advancement in Black, White and Yellow Mycosis

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ABSTRACT

As the Covid-19 virus, the infection is caused by SARS-COV-2 has an effect on the respiratory system of the human body. In the second wave of covid-19, mucormycosis infection has been identified. Mucormycosis infection is not contagious and is not transmitted from one person to another, but this is fungal infection that can affect more than just one side to be infected with the same person. When people come into contact with spores, fungus, infection occurs. It develops on the skin, in the nose, brain, paranasal sinuses, lungs, etc. This is a disease which manifests itself in those patients who had returned to the public health or recovering from covid-19, that is, to the situation with covid-19. This is a problem that occurs as a result of high blood glucose levels, hematologic cancer, iron deficiency, the use of steroids in the treatment of covid, etc. As a result of the condition of the body, the human system is weak, this is the body in an acidic environment and it is more susceptible to fungal development. Most recently, in black, white, and yellow, fungal infections have been published. The nomenclature of the fungal cell membrane and determines the site, and is not in the mycological classification, for example, in the area of the head, the neck. The process of making the diagnosis of a fungal infection, it is not only because of the introduction of the fungal cell membrane component is carried out by a cytological preparation. In the treatment of a fungal infection in the search for its causes, symptoms, and risk factors. For the treatment of mycotic infection, liposomal amphotericin b, and triazoles derivatives, i.e., isaconazole, posaconazole is highly beneficial in treatment.

KEYWORDS: Black Fungus, Covid-19, Diagnosis, Mucormycosis, Symptoms, Treatment, Weak Immune System, White Fungus, Yellow Fungus etc.

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I. INTRODUCTION

The name mucormycosis is derived from the German name Mucormycosis. German pathologist Paltaut in 1885, described as 'Mycosis Mucorina' And this year diagnosed mucormycosis was discovered. In 1876, Furbinger described in Germany a patient who died of cancer in this patient with right lungs showing hemorrhagic infection with fungal high hyphae and a few sporangia.^[4] The term 'Mucormycosis' was widely used by the American pathologist R.D. Baksh. In the previous Mucormycosis i.e., Black fungus is called Zygomycosis. It is a serious but rare fungal disease that occurs due to a fungus in the mucorales order. Basically, the type of fungus that is, the fungus is not a yeast or not a fungus. Mycosis infection caused by inhaling fungal particles or a local colony formed on the skin can start to become infected. The disease usually begins in the lungs or skin. People with weakened immune systems and an acidic immune system that occurs in the treatment of covid-19 are at risk of developing fungus. In severe cases of fungal infection is popular.

I. Link between covid-19 and mucormycosis

Mucormycosis infection was seen in a small number in India before covid-19 too, but it is now affecting post covid patients in large numbers.^[22,23]

In SARS-COV-2 infection and covid-19 treatment indiscriminate steroidal use for example dexamethasone, corticosteroids increase blood sugar level and decrease immune system.^[23] Not only in covid-19, but steroids are mostly used in pulmonary disease and orthopaedic patients that suppress the immune system.^[23] Due to these features covid-19 patients face a renewed risk of failing the battle against attack mounted by organisms such as mucormycetes.^[23]

In severe covid-19 treatment long term ventilation process can decrease immunity and fungus being transmitted by humidifier water being given along with oxygen.^[23] In this case, oxygen support for people with severe covid-19 can cause drying of the nasal cavity and further increased risk of mucormycosis. Because it spreads through the respiratory tract and erodes facial structure.^[23]

After covid-19, higher rates of mucormycosis cases in India are due to combination factors. For example, more than 30 million people in India have diabetes. Number of cases of mucormycosis before covid-

19 is pandemic was relatively low, although prevalence was rising.^[23] As a covid-19 is a viral infection that the virus as a part of replication cycle suppresses the immune system for example, HIV infection of course, which causes long-term immune suppression.^[23] Antifungal medication like voriconazole inhibit aspergillus but mucor remains on cascade and due to lack of competition.^[23] Covid-19 treatment damages the mucosa and blood vessels and increases iron in serum which is an important factor for fungus to grow.^[23]

II. Mucor

Fungus is ubiquitous in nature which is found in soil, plants, decaying organic matter, water, air, damp places, animals and humans also.^[31] Fungus play a very important role in the ecosystem along with bacteria by degrading organic matter into simpler form for consumption of plants, for example household yeast, moulds, mushrooms etc.^[32]

Basically, the black fungus is not a plant because plants do photosynthesis. These molds cannot do photosynthesis. So, they look like eukaryotic or animal systems, not as a plant system. Black fungus does not prepare their own food. They have to collect fuels from outside and then they convert it into nutrition. This fungus is a mixture of animal cells and plant cells.^[33] Mucor is naturally found everywhere in the environment. There are around 50 species distributed worldwide. Due to the mucor species of mould mucormycosis disease conditions occur and they might affect mucous membrane skin, eyes, lungs etc.

Classification

- Kingdom: Mycota
- Division: Zygomycota
- Sub-division: Zygomycotina
- Class: Zygomycetes
- Order: Mucorales
- Family: Mucoraceae
- Genus: Mucor

Characteristics

1. “Black” or “Bread mould” is another name of Mucor.
2. Mostly the mode of nutrition is Saprophytic (i.e., grow in dead matter) also for others, Coprophilous (i.e, grow in the dung of herbivorous animals.)
3. Various varieties of Mucor grow on bread, jam, jellies, etc.
4. Eucarpic is the vegetative body of the Mucor.
5. Glycogen and Oil droplet is the form of major reserve food material.
6. Cellulose and Chitin is the composition of Mucor cells.

Structure

The three features of Mucor structure are:

- Morphological
- Macroscopic
- Microscopic

In the structure of Mucor, there are two horizontal branches which are Subterranean hyphae and Prostrate hyphae also one vertical branch which is Aerial hyphae. Hyphae is a multinucleated thread-like thin structure in the form of Mycelial network.^[34] After getting mature, they develop a receptor but they do not have Septa. Mucor does not have Septa (a long thread that can identify individual cells as nuclei are present in that thread which means thread boundary of the cell is not clear). In the horizontal line, on the surface of substrate molds are growing e.g. rotten fruits, rotten flowers.

In the structure of mucor sporangia, sporangiophore, sporangiophore, columella play an important role in the function of fungus.

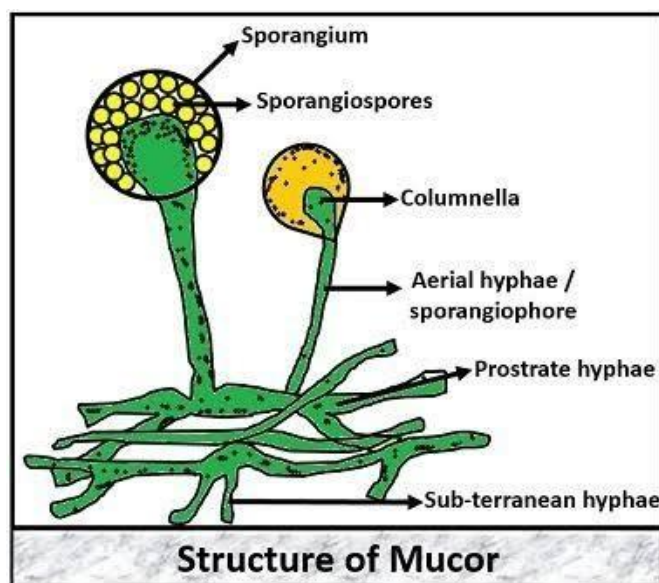


Fig.1 Structure of Mucor

List of fungi species that causes Mucormycosis

1. Rhizopus Species.
2. Mucor Species.
3. Rhizomucor Species
4. Syncephalastrum
5. Cunninghamella
6. Absidia
7. Aspergillus
8. Candida Auris
9. Talaromyces
10. Cryptococcus
11. Histoplasma
12. Pneumocystis

III. Black fungus

Mucormycosis is a serious but rare infection caused by exposure to mucor mold which is naturally present in the environment. Commonly found in soil, plant decaying fruits, vegetables etc. ^[21,27,35] It mainly affects the people who are on medication treatment for health issues. E.g. diabetes, hypertension, etc. The medication reduces the ability to fight environmental pathogens. The body organs that are affected here are brain, lungs, sinuses, etc. The black fungus infection is mainly seen in Madhya Pradesh, Telangana, Gujarat, Andhra Pradesh, Haryana, Karnataka, Maharashtra Rajasthan. ^[21]

Types of Mucormycosis:

1. Rhinocerebral (sinus and brain) Mucormycosis Symptoms

- One side facial swelling
- Headache
- Nasal/Sinus congestion
- Black lesions on nasal bridge
- Fever
- Pain and Redness around eye/nose
- Bloody/Blackish vomit
- Altered mental state
- Loosing of teeth
- Blurred/Double vision with pain

- Thrombosis
- Necrosis

Rhinocerebral Mucormycosis is a rare opportunistic infection which is occurred in sinuses, oral cavity, brain, nasal passage due to saprophytic fungi. This infection occurs by inhalation of spores. [37,38] There are more chances of death due to risk factors of Diabetes Mellitus, Solid Organ Transplant, Hematologic Malignancy and patients in immunosuppressed state. Wide range of fungal coinfection may exist and may be associated with preexisting morbidity. [29] It also may develop hospital acquired infections such as Ventilator Associated Pneumonia. [5,7,18]

2. Pulmonary Mucormycosis Symptoms:

- Cough
- Chest Pain
- Shortness of breath
- Fever

Pulmonary Mucormycosis is an uncommon fungal infection and mostly seen in immune-compromised patients. This infection occurs by inhalation of spores. Here also, there are more chances of death due to risk factors of Diabetes Mellitus, Solid Organ Transplant, Hematologic Malignancy and patients in immunosuppressed state. [8,13,15,21]

3. Cutaneous Mucormycosis Symptoms:

- Blister or ulcer
- Skin wounds
- Swelling around wounds
- Pain
- Turn black skin

Cutaneous Mucormycosis infection seen in patients having contamination of skin wounds. It occurs due to Phylum Glomeromycota having nature of angioinvasive. This infection can spread fastly from skin to deep tissue and bone Untreated skin infection will result in tissue infarction, thrombosis and necrosis. [4]

4. Gastrointestinal Mucormycosis Symptoms:

- Nonspecific abdominal pain
- Nausea
- Vomiting
- Gastrointestinal bleeding
- Hematochezia
- Fever

Gastrointestinal Mucormycosis infection caused by fungi of order Mucorales, in most cases caused by Rhizopus. Which is found in decaying vegetables and soil. It is a rare but lethal infection due to invasion of Mucorale. [4]

5. Disseminated Mucormycosis Symptoms:

- Headache
- Nasal Bridge
- Black lesion
- Fever

Disseminated Mucormycosis occurs when infection spreads through the bloodstream to affect another part of body e.g. Brain, Heart, Spleen, skin etc.

Risk Factors and Epidemiology

The causative agents in order to new carols include 261 species in 55 genera 38 of which have been associated with human infection. The body having condition is a low immunosuppressive in Diabetes mellitus, Steroid use i.e. corticosteroid, hypertension, Prolonged ICU use, Hematological malignancies, hematopoietic stem cell transplantation (HSCT) Leukemia, Iron overloaded, Autoimmune disease condition, Over use Voriconazole therapy, AIDS, Renal failure, Liver failure, Chronic

alcoholism, Malnutrition, Low birth weight of foetal, Neutropenia, Post pulmonary tuberculosis etc. Above mentioned body condition is are prone to infection of mycosis. ^[1,2,4,6,9,10]

Epidemiology mucormycosis looks for a weak immune system and acidic environment to be able to start growing faster and once growing fast then getting ahead of it is difficult to stop the infection. It does cause blood vessels to become fungal, it grows in the Wall of blood vessels, occludes and blocks. It causes blood supply of Oxygen and especially in the nose area from there to the cribriform plate. It will show to the brain, eyes, and jaw to the respiratory system that it causes dead tissue. ^[17,19] It is opportunity it has to be situation where person immune system is down and the acidic environment occur. ^[20] This environment is more susceptible to the mucor growth. The human immune system going to be down Prolonged ICU stay means a person on unclean and hygienic situation there is the chances of infection occurs from hospital area. ICU patients having a weaker immune system this person definitely going to be acidic environment because of the use of medicine which is treat covid and other made medicinal condition for their own bodies state so causes person to be at the risk of mucormycosis and unclean devices tube Nestle Kanu cools vagina tense do so on the ventilator tubes renal and her disease.

Both types of diabetes people can be susceptible to mycosis is especially uncontrolled diabetes having suppressed immune systems because immune cells do not have enough energy to function correctly and then cannot fight. ^[16] Because type 1 diabetes there is ketoacidosis and as soon as an acidic environment occurs then mycosis can start growing. In type 2 diabetes there is glucose level that is high so lactic acidosis occurs. Then they damage the cell. Use of steroids in covid treatment lowers the immune system. ^[9,10]

Prevention

- Use a mask if visiting dusty construction sites.
- Wear shoes, long trousers, long sleeve shirts and gloves while handling soil mass.
- Maintain good hygienic conditions and keep the surroundings clean.
- Avoid unnecessary use of broad-spectrum antibiotics, antifungal, steroids.

Diagnosis

According to disease condition, medical history, symptoms, physical examination diagnosis is done. ^[11,12] In diagnosis process lab test, tissue biopsy, nasal endoscopy, fungal culture test, CT scan of sinuses and lungs. When any symptoms of mycosis infection are observed then as possible early diagnosis is a challenging process this is the most important step because delay in diagnosis. It clearly impacts mycosis recovery rate.

Treatment

Mucormycosis is treated by antifungal medicine. This is given by two routes

Oral Route

1. Liposomal amphotericin B
2. Posaconazole
3. Isavuconazole

Amphotericin B has a high daily dose for long period treatment and statically improves patient outcome but it has limited therapeutic activity because of severe side effects. ^[38]

Intravenous Route:

1. Posaconazole
2. Isavuconazole

In severe condition will have to surgically remove infected body parts to stop infection from reaching the brain. Surgery effectively depends on availability of surgical technique.

Role of surgery

- Remove of devitalized tissue
- To establish histopathology
- Debulking of infected tissue



Fig. 2 Black Fungus Infection

IV. White fungus

The infection caused by candida fungal species. It is more dangerous than black fungus that can spread to several body parts: skin, mouth, brain, nails, stomach and private parts. The first case of white fungus infection is seen in Bihar and Madhya Pradesh. According to Dr Kaushal Verma professor of all India institute of medicinal science this fungus infection starts from the tongue or private part and the tongue becomes white and then sprayed into another part. White fungus is present indoors and outdoors. The symptoms of white fungus infection are similar to covid and which is detected by CT scan.

The low immunity peoples are more prone to this fungal infection, people having preexisting medication issues that are diabetes mellitus cancer steroid use and prolonged ICU treatment. so important to maintain immunity power. In severe condition, side effect kidney and liver damage

Symptoms

- Fever
- Diarrhoea
- Dark white spots on lungs
- Reduce oxygen level
- White patches in oral cavity
- Skin lesions
- Coughing
- **Prevention**
- Keep the surroundings clean, free from dust particles and maintain good hygienic conditions.
- Maintain immunity power. **Diagnosis and treatment**

In the diagnosis process check the severity of infection and microscopic observation test. In treatment, antifungal medicine is preferred. e.g. Voriconazole, Liposomal amphotericin B. In severe condition, by using surgery, removal of white patches etc.

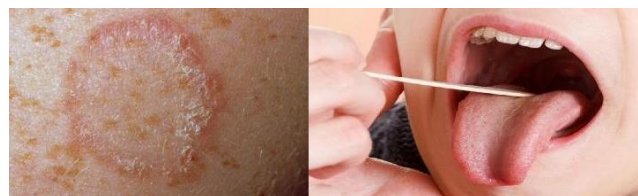


Fig. 3 White Fungus Infection

V. Yellow fungus

The first case of yellow fungus infection was reported from Ghaziabad in Uttar Pradesh.[24] A age 59 years old patient tested positive for this infection in NCR City. The yellow fungus infection is mostly observed in reptiles not in humans. Yellow fungus infection is more dangerous or severe than black and white fungus infection. This infection starts internally causing first leakage and then it leads to slow healing of wounds. [30,31] In serious cases organ failure and cell injury occur. Once the inhalation of fungus spores and then it affects sinuses, cavity, lungs and chest cavity of the patient. This occurs due to unsanitary conditions and patients having weak immune systems and steroid treatment in covid-19.

Symptoms

- Lethargy
 - Fatigue
 - Poor appetite
 - Weight loss
 - Poor metabolism
 - Sunken eye
 - Malnutrition
- Prevention**
- Mostly fungal infections spread due to bad hygienic conditions. Maintain surrounding cleanliness.
 - Remove rotten food, contaminated food that prevent growth of fungus or bacteria.
 - Humidity is the important factor for growth of fungal so maintain humidity in between 30% to 40%. High moisture in the ear allows proliferation of fungus. [25,26]
- Treatment**
- Proper ventilation.
 - Broad spectrum antifungal
 - Liposomal amphotericin B injection



Fig. 4 Yellow Fungus Infection

II. DISCUSSION

Mucormycosis infection is most frequently a rise in a patient with weak immune system in post covid patients. This infection is pandemic and has high mortality and morbidity. Recently, symptoms and treatment of fungal infection are common for various types of fungus. After black mucormycosis nasal aspergillosis cases rise. Especially in low and middle-income countries there is increased mucormycosis cases and the show is alarming. In developed countries hematological malignancies post pulmonary tuberculosis, orthopedic, chronic renal failure disease patients are more. The most important preventive measure against filamentous fungus in fiction remains the decrease of environmental majors. For example, covid-19 patients with mucormycosis who were admitted to the HEPA filter room. Due to the severity of post covid-19 necrosis diagnosis remains challenging. Fluconazole and itraconazole should not be used for prophylaxis for treating mucormycosis; this is given lack of both in vitro and in Vivo susceptibility.

III. CONCLUSION

Post covid-19 situation, that is mucormycosis, is declared as an epidemic and in this pandemic situation patients have to keep strong immunity power and maintain a healthy surrounding environment and good hygienic condition. Mucormycosis is better to identify by its name rather than color. The question still comes about the causes and origin of covid-19 increasing the prevalence in post covid-19 patients so more work on research is required for better management of opportunistic infection in covid-19 patients. Pulmonary aspergillosis is usually seen in weak immune system patients, but aspergillosis of the sinus is rare. The disease is now seen in those patients who have been cured of Covid or currently in treatment.

REFERENCES

- [1]. Oliver A Cornely et al. Global guideline for the diagnosis and management of mucormycosis: an initiative of the European Confederation of Medical Mycology in cooperation with the Mycoses Study Group Education and Research Consortium. *Lancet Infect Dis.* 2019 Dec.
- [2]. Livio Pagano et al. Mucormycosis in hematologic patients. *Haematologica.* 2004 Feb.
- [3]. G N Pongas et al. Voriconazole-associated zygomycosis: a significant consequence of evolving antifungal prophylaxis and immunosuppression practices? *Clin Microbiol Infect* 2009 Oct.
- [4]. Anna Skiada et al. Epidemiology and Diagnosis of Mucormycosis: *J Fungi (Basel).* 2020
- [5]. Aastha Maini et al. Sino-orbital mucormycosis in a COVID-19 patient: *Int J Surg Case Rep.* 2021.
- [6]. Deepak Garg et al. Coronavirus Disease (Covid-19) Associated Mucormycosis (CAM): Case Report and Systematic Review of Literature *Mycopathologia.* 2021 May.
- [7]. Amanda Werthman-Ehrenreich. *Am JEerg Med.* Mucormycosis with orbital compartment syndrome in a patient with COVID-19. 2021 Apr.
- [8]. Rishi Agrawal et al. Pulmonary Mucormycosis: Risk Factors, Radiologic Findings, and Pathologic Correlation Radiographics. May-Jun 2020.
- [9]. H N Hulter et al. Effects of glucocorticoid steroids on renal and systemic acid-base metabolism. *Am J Physiol.* 1980 Jul.
- [10]. Lawrence S Weisberg. Lactic Acidosis in a Patient with Type 2 Diabetes Mellitus. *Clin J Am Soc Nephrol.* 2015.
- [11]. George Petrikos, Anna Skiada, Olivier Lortholary, Emmanuel Roilides, Thomas J. Walsh, Dimitrios P. Kontoyiannis *Epidemiology and Clinical Manifestations of Mucormycosis*
- [12]. *Clinical Infectious Diseases, Volume 54, Issue suppl_1, February 2012, Pages S23–S34, Published: 01 February 2012*
- [13]. Rishi Agrawal, Anjana Yeldandi, Hatice Savas, Nishant D. Parekh, Pamela J. Lombardi, Eric M. Hart. Pulmonary Mucormycosis: Risk Factors, Radiologic Findings, and Pathologic Correlation Published Online: Mar 20 2020
- [14]. Kontoyiannis DP, et al. Future directions in mucormycosis research. *Clin Infect Dis.* 2012. PMID: 22247450 Free PMC article.
- [15]. Andre K Johnson et al. Pulmonary aspergillosis and mucormycosis in a patient with COVID-19 *Med Mycol Case Rep.* 2021 Jun.
- [16]. Mohamed I Abdelwahab Hassan et al. Pathogenicity patterns of mucormycosis: epidemiology, interaction with immune cells and virulence factors. *Med Mycol.* 2019.
- [17]. Shweta Mallikarjun Revannavar et al. COVID-19 triggering mucormycosis in a susceptible patient: a new phenomenon in the developing world? *BMJ Case Rep.* 2021.
- [18]. Salomon Waizel-Haiat et al. A Case of Fatal Rhino-Orbital Mucormycosis Associated With New Onset Diabetic Ketoacidosis and COVID-19 *Cureus.* 2021.
- [19]. Deepak Garg et al. Coronavirus Disease (Covid-19) Associated Mucormycosis (CAM): Case Report and Systematic Review of Literature. *Mycopathologia.* 2021 May.
- [20]. Ashraf S. Ibrahim, Brad Spellberg, Thomas J. Walsh, Dimitrios P. Kontoyiannis Pathogenesis of Mucormycosis. *Clinical Infectious Diseases, Volume 54, Issue suppl_1, February 2012, Pages S16–S22, Published: 01 February 2012*
- [21]. https://www.financialexpress-com.cdn.ampproject.org/v/s/www.financialexpress.com/lifestyle/health/mucormycosis-doctor-explains-types-of-black-fungus-medical-tests-to-diagnose-them/2261277/?amp_gsa=1&_js_v=a6&usqp=mq331AQFKAGwASA%3D#amp_tf=From%20%251%24s&aoh=16223461678999&csi=1&referrer=https%3A%2F%2Fwww.google.com&share=https%3A%2F%2Fwww.financialexpress.com%2Flifestyle%2Fhealth%2Fmucormycosis-doctor-explains-types-of-black-fungus-medical-tests-to-diagnose-them%2F2261277%2F
- [22]. https://www.dnaindia-com.cdn.ampproject.org/v/s/www.dnaindia.com/india/report-after-black-fungus-another-fungal-infection-nasal-aspergillosis-on-rise-8-patients-in-gujarat-2892224/?amp_gsa=1&_js_v=a6&usqp=mq331AQFKAGwASA%3D#amp_tf=From%20%251%24s&aoh=16221980478959&csi=1&referrer=https%3A%2F%2Fwww.google.com&share=https%3A%2F%2Fwww.dnaindia.com%2Findia%2Freport-after-black-fungus-another-fungal-infection-nasal-aspergillosis-on-rise-8-patients-in-gujarat-2892224
- [23]. <https://www.medicalnewstoday.com/articles/covid-19-increases-black-fungus-infection-risk-in-india>
- [24]. https://m-businesstoday-in.cdn.ampproject.org/v/s/m.businesstoday.in/lite/story/mucormycosis-after-black-white-first-case-of-yellow-fungus-appears-in-ghaziabad/1439877.html?usqp=mq331AQHKAFQArABIA%3D%3D&_js_v=a6&_gsa=1&referrer=https%3A%2F%2Fwww.google.com&csi=1&share=https%3A%2F%2Fwww.businesstoday.in%2Fcoronavirus%2Fmucormycosis-after-black-white-first-case-of-yellow-fungus-appears-in-ghaziabad%2Fstory%2F439877.html
- [25]. https://www.newindianexpress-com.cdn.ampproject.org/v/s/www.newindianexpress.com/nation/2021/may/25/dont-panic-by-colour-of-fungus-look-for-causes-risks-experts-advice-as-mucormycosis-cases-rise-2307366.amp?amp_js_v=a6&_gsa=1&usqp=mq331AQHKAFQArABIA%3D%3D#aoh=16220150333013&_ct=1622015056834&csi=1&referrer=https%3A%2F%2Fwww.google.com&_tf=From%20%251%24s&share=https%3A%2F%2Fwww.newindianexpress.com%2Fnation%2F2021%2Fmay%2F25%2Fdont-panic-by-colour-of-fungus-look-for-causes-risks-experts-advice-as-mucormycosis-cases-rise-2307366.html
- [26]. https://m-businesstoday-in.cdn.ampproject.org/v/s/m.businesstoday.in/lite/story/black-fungus-white-fungus-yellow-fungus-how-are-they-different/1439987.html?amp_js_v=a6&_gsa=1&usqp=mq331AQHKAFQArABIA%3D%3D#aoh=16220143689239&_ct=1622014375759&csi=1&referrer=https%3A%2F%2Fwww.google.com&_tf=From%20%251%24s&share=https%3A%2F%2Fwww.businesstoday.in%2Fcurrent%2Feconomy-politics%2Fblack-fungus-white-fungus-yellow-fungus-how-are-they-different%2Fstory%2F439987.html
- [27]. https://m-timesofindia-com.cdn.ampproject.org/v/s/m.timesofindia.com/life-style/health-fitness/health-news/yellow-fungus-cases-reported-in-up-know-why-it-can-prove-more-dangerous-than-black-fungus-white-fungus/amp_etphotostory/82905030.cms?amp_js_v=a6&_gsa=1&usqp=mq331AQHKAFQArABIA%3D%3D#aoh=16220139935006&_ct=1622013998152&csi=1&referrer=https%3A%2F%2Fwww.google.com&_tf=From%20%251%24s
- [28]. https://www.newindianexpress-com.cdn.ampproject.org/v/s/www.newindianexpress.com/nation/2021/may/19/mucormycosis-new-nemesis-for-maharashtra-90-deaths-in-state-so-far-due-to-fungal-infection-amid-dow-2304792.amp?amp_js_v=a6&_gsa=1&usqp=mq331AQHKAFQArABIA%3D%3D#aoh=16220028412346&_ct=1622002855466&csi=1&referrer=https%3A%2F%2Fwww.google.com&_tf=From%20%251%24s&share=https%3A%2F%2Fwww.newindianexpress.com%2Fnation%2F2021%2Fmay%2F19%2Fmucormycosis-new-nemesis-for-maharashtra-90-deaths-in-state-so-far-due-to-fungal-infection-amid-dow-2304792.html
- [29]. <https://qz-com.cdn.ampproject.org/v/s/qz.com/india/2012257/why-india-has-so-many-cases-of-mucormycosis-or-black->

- fungus/amp/?amp_js_v=a6&_gsa=1&usqp=mq331AQHKAFQArABIA%3D%3D#aoh=16220023468042&_ct=1622002381382&csi=1&referrer=https%3A%2F%2Fwww.google.com&_tf=From%20%251%24s&share=https%3A%2F%2Fqz.com%2FIndia%2F2012257%2Fwhy-india-has-so-many-cases-of-mucormycosis-or-black-fungus%2F
- [30]. <https://www.seminaronly.com/tech/yellow-fungus-wikipedia.php>
- [31]. https://www-businessinsider-in.cdn.ampproject.org/v/s/www.businessinsider.in/science/health/news/what-is-black-white-and-yellow-fungus-symptoms-and-prevention/amp_articleshow/82938920.cms?amp_js_v=a6&_gsa=1&usqp=mq331AQHKAFQArABIA%3D%3D#aoh=16220013796085&_ct=1622001396744&csi=1&referrer=https%3A%2F%2Fwww.google.com&_tf=From%20%251%24s&share=https%3A%2F%2Fwww.businessinsider.in%2Fscience%2Fhealth%2Fnews%2Fwhat-is-black-white-and-yellow-fungus-symptoms-and-prevention%2Farticleshow%2F82938920.cms
- [32]. <https://biologyreader.com/mucor.html>
- [33]. <https://en.m.wikipedia.org/wiki/Fungus>
- [34]. <https://en.m.wikipedia.org/wiki/Mucorales>
- [35]. https://www-financialexpress-com.cdn.ampproject.org/v/s/www.financialexpress.com/lifestyle/health/black-fungus-in-covid-19-patients-causes-symptoms-and-treatment-explained/2256974/lite/?amp_js_v=a6&_gsa=1&usqp=mq331AQHKAFQArABIA%3D%3D#aoh=16218485859043&_ct=1621848676288&csi=1&referrer=https%3A%2F%2Fwww.google.com&_tf=From%20%251%24s&share=https%3A%2F%2Fwww.financialexpress.com%2Flifestyle%2Fhealth%2Fblack-fungus-in-covid-19-patients-causes-symptoms-and-treatment-explained%2F2256974%2F
- [36]. https://www-bbc-com.cdn.ampproject.org/v/s/www.bbc.com/news/world-asia-india-57027829.amp?amp_js_v=a6&_gsa=1&usqp=mq331AQHKAFQArABIA%3D%3D#aoh=16218482584550&_ct=1621848337999&csi=1&referrer=https%3A%2F%2Fwww.google.com&_tf=From%20%251%24s&share=https%3A%2F%2Fwww.bbc.com%2Fnews%2Fworld-asia-india-57027829
- [37]. <https://www.thehindu.com/sci-tech/health/explained-what-is-mucormycosis-and-what-causes-the-infection-in-covid-19-patients/article34568164.ece>
- [38]. https://indianexpress-com.cdn.ampproject.org/v/s/indianexpress.com/article/explained/mucormycosis-in-covid-patients-fungal-infections-7308721/lite/?amp_js_v=a6&_gsa=1&usqp=mq331AQHKAFQArABIA%3D%3D#aoh=16217718152664&_ct=1621771822423&csi=1&referrer=https%3A%2F%2Fwww.google.com&_tf=From%20%251%24s&share=https%3A%2F%2Fwww.indianexpress.com%2Farticle%2Fexplained%2Fmucormycosis-in-covid-patients-fungal-infections-7308721%2F

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