

AN INSIGHT OF MUCORMYCOSIS IN TERMS OF MODERN MEDICINE AND AYURVEDA

Dr Rushikesh G Pawade¹ & Dr Alka Charde²

¹PG-Scholar, Department of Rachana Sharir, Bhausahab Mulak Ayurved Mahavidyalaya
Nandanwan, Nagpur, Maharashtra, India

²HOD, Professor & PG Guide, Department of Rachana Sharir, Bhausahab Mulak Ayurved
Mahavidyalaya Nandanwan, Nagpur, Maharashtra, India.

ABSTRACT

Mucormycosis is an opportunistic angio-fungal illness that has returned owing to a variety of factors during the COVID-19 pandemic. Because of the limits of existing therapies, prevention is the preferred method. Fungi have the ability to invade blood vessels and can affect different parts of the body. The most common, though the most aggressive, form is cerebro-rhino-orbital Mucormycosis that occurs in debilitated patients, in conjunction with sinus or para-sinus involvement. Ayurveda has a vital role to play in prevention, which requires a previous grasp of the problem in its own jargon. Mucormycosis is an external disorder that exhibits divergent symptoms after originally following a shared pathogenetic pattern. In terms of diet, regimen, medication, and treatments, Kapha and Pitta (particularly in terms of Snigdha and Usna characteristics) have a significant impact. Current Ayurvedic knowledge should be applied successfully in diagnosing, staging, preventing, and treating mucormycosis patients. Their curative role as adjuvant and standalone therapies are subjected to further research.

Key-words - Antifungal, Ayurveda, COVID-19, Fumigation, Mucormycosis

Introduction

Mucormycosis is an opportunistic angio-fungal illness that mostly affects those with inadequate immunity. This illness, which is most common in tropical areas, is more frequent in Asia, with India leading the way. Mucormycosis is a fungus of the Phycomycetes class, sometimes known as zygomycosis or phycomycosis. It is induced by spore inhalation, and the most prevalent genera responsible for infection are *Mucor* and *Rhizopus*. The human immune system is capable of eliminating a wide range of infections. However, due to the usage of immunosuppressants and corticosteroids, the vulnerability to fungal infection has increased. Because the target site of eukaryotic pathogens is comparable to that of humans, the pharmaceutical target for treating fungal illness has become restricted. Mucormycosis fungus thrives on rotting vegetables, bread, dirt, and dust. People are exposed to these moulds by spore inhalation, contaminated food consumption, or inoculation of damaged skin or wounds. They generate black lesions after infection, which is why Mucormycosis is sometimes known as black fungus. Data from the previous two decades show that Mucormycosis is a terrible fungal illness with a high fatality rate.

The most frequent type, Orbitorhinocerebral Mucormycosis, is usually associated with sinus or nasal involvement. Mucormycosis can potentially affect other organs such as the lungs, gastrointestinal tract, or skin. There is no information about age, gender, or race. This condition commonly manifests as orbital and facial discomfort, sinusitis, headache, fever, vision disturbances, nasal discharge, or

stuffiness. Proptosis, ophthalmoplegia, periorbital edema, reduced vision, and a change in mental state may be discovered during a physical examination. Necrotic tissue, which resembles a black eschar, can be visible on the nasal turbinates, septum, and palate. Patients on long-term antibiotics, steroids, or cytotoxic medication, as well as those with diabetes, chronic renal failure, liver issues, transplants, cancer, HIV, malnutrition, or acidosis, are more likely to develop the condition.

As a result, there is presently a need for integrated methods for identifying at-risk people and implementing effective, evidence-based preventative actions. This is when ancient knowledge systems like Ayurveda come into play. In addition to static disorders, Ayurveda has uncovered and documented dynamic disease patterns. As a result, the descriptions of these diseases have acted as templates into which fresh and newer diseases that have plagued science might be included and successfully controlled. Furthermore, the characteristics included in the diagnostic and therapeutic decision-making algorithm allow a physician to select specific, tailored interventional treatments for the disease found. To do this, each new illness entity, whether or not it fits the written description, must be rigorously assessed in terms of these factors from several angles. There have been no attempts to date to characterize the nosology of this illness from an Ayurvedic perspective, which is what this article attempts to achieve.

Pathophysiology

Sporangiospore ingestion, inhalation, or inoculation of spores through wounds or trauma, inhalation of saturated oxygen,

medical equipment, or an inadequate ventilation system are all ways that black fungus enters a patient. Phagocytes play a vital function in Mucorales infection. Mold hyphae and spores that induce mucormycosis are easily combated by mononuclear or polymorphonuclear phagocytes. As a result, those with a low phagocyte count or reduced phagocytosis function are more vulnerable to black fungus infections. Excessive chemotherapy might cause neutropenia, making you a soft target for this mucormycosis. Furthermore, patients with impaired neutrophil function as a result of poor blood glucose management, acidic pH, and ketoacidosis hyperglycemia may significantly harm motility and phagocytic function. Furthermore, phagocytic activity can be hampered by an overdose of glucocorticoids, causing them to be unable to destroy the ingested Mucorales. Mucormycosis has a unique method for invading endothelial cells from the circulatory system, allowing infection to spread from one portion of the body to another.

Clinical Features

Mucormycosis of the sinuses first affects the turbinates and paranasal sinuses. At this stage, symptoms such as sinus discomfort, congestion, mouth or face pain, hyposmia, and anosmia may be indistinguishable from those of more prevalent causes of sinusitis. The nasal mucosa appears erythematous at first, then dark purple and black with the commencement of tissue necrosis. The appearance of necrotic eschars on the nasal mucosa or hard palate, as well as bloody nasal discharge, are sentinel symptoms that doctors should look for to rule out mucormycosis. Periorbital

edema, proptosis, and ophthalmoplegia are symptoms of orbital extension. Blurred vision and infra-orbital face numbness are symptoms of optic nerve and infraorbital nerve invasion, respectively. Often, the cavernous sinus is the first intracranial structure to be affected. Cavernous sinus thrombosis can impede the function of the ocular motor nerves III, IV, and VI, as well as the ocular nerve and trigeminal nerve branches V1 and V2, which pass through it. Brain invasion and infarction are indicated by hemiparesis, altered awareness, and focal convulsions.

Facial discomfort with swelling, headache, fever, sinusitis, rhinitis, granular or purulent nasal discharge, nasal ulceration, epistaxis, hemiplegia or stroke, and reduced mental function are common non-ocular symptoms. These symptoms might last anywhere from a few days to many weeks. Orbital involvement is often caused by disease dissemination from the paranasal sinuses; however, clinical involvement of the sinuses or nose may be absent. The condition is often unilateral and stays thus in the majority of instances, while bilateral cases can occur. The eyelids or parts of the face around the nose or maxillary sinus may become erythematous, violaceous, or gangrenous. A purulo-sanguineous effusion with an unpleasant odour or black necrotic tissue that resembles dried blood. The afflicted area's bone and cartilage are compromised by ischemia necrosis and may become mushy, resulting in perforation. Orbital cellulitis might be followed with lid and orbital contents infarction.

One or more of the following ocular signs and symptoms are present:

Lid and periorbital swelling, fungal eyelid abscesses, ptosis, chemosis, corneal oedema, decreased vision, orbital cellulitis, orbital abscesses, superior orbital fissure syndrome, superior ophthalmic vein thrombosis, optic disc oedema, corneal anaesthesia, external ophthalmoplegia (total or partial), internal ophthalmoplegia.

The classical clinical progression includes three stages

- Stage I: Infection of the nasal mucosa and sinuses.
- Stage II: Orbital involvement (orbital apex syndrome, superior orbital fissure syndrome).
- Stage III: Cerebral involvement in which intracranial spread occurs via one of the following routes:

- i. Ophthalmic artery
- ii. Superior orbital fissure
- iii. Cribriform plate.

The spread of the infection to the frontal lobes and to the cavernous sinus occurs via perivascular and perineural channels through the cribriform plate and the orbital apex, respectively [28].

Ayurveda View

Fungal diseases are classified as foreign, toxin-induced illnesses in Ayurveda. Contact with poisonous plant spores has been shown to produce extrinsic edema and ulceration. These edematous lesions spread quickly and develop into ulcerations. The pathogen in this context contains all of the general characteristics of the poisonous materials (Visha) listed in Ayurveda, namely the ability to give dryness (Rukata) and heat (Uatva) to the body, as well as the ability to traverse narrow pathways. As a result, it has access to every place in the body, acts quickly (Asukari), instantly becomes homogeneous with the body (Vyavayi),

destroys bodily structures (Vikrati), is light (Laghu) and unmetabolizable (Apaki), and becomes difficult to cure as well as self-eliminated. Despite their pervasiveness, these fungal spores do not impact everyone. Most of the time, the host's immune system prevents them from invading (Bala). The optimality of the Kapha Dosha in the body is known as Bala. It is regarded as the pinnacle of good metabolism, which is anchored in the digestive fire (Agni). Dosha, dushya, bala, agni, and prakriti Individuals who consume foods and practices that disrupt the digestive system, derange the Kapha and Pitta Dosha, especially in the form of increased wetness (Kleda), have an influence on fat tissue (Medo Dhatu); they have lower Bala profiles despite clinical indicators of elevated Kapha Dosha (since it is an increase in the form of metabolic waste and not the essence).

They also have a protracted and pathogenic period of semidigested, fermented, and acidic content during the metabolic process (Vidaha). According to Ayurveda, these people are more prone to infections and infestations (Krimi), dermatological disorders (Kuha), diabetes (Prameha), inflammation and edema (Sopha), and various ailments affecting the nose, eyes, and throat. Bala is regulated by blood robustness in terms of both quality and quantity. The observations of increased lipid metabolism in fungi and results that an individual's Dosha genotype (Prakriti) predisposes him to the illnesses prevalent in that specific Dosha (Nanatmaja diseases) point to the condition's tendency to Kapha-Pitta Prakriti. Kala, Desha Though there is limited evidence on the disease's geographical and

seasonal spread, there are hints that it is more frequent in tropical regions and climates.

In India, the prevalence has been observed to be higher in the post-rainy season and autumn seasons, which are consistent with Ayurvedic observations in which the former is mentioned to be the

one in which Agni and Bala are diminished, and the sudden cooling of the heated earth makes it acidic (resulting in an increase in Pitta and Kapha); this state is further exacerbated in the latter when the earth is further heated up, resulting in an increase in Pitta and Kapha.

Table 1: Etiopathogenesis of Mucormycosis in Ayurveda

	Features
Etiological factors	Pathogen - Viṣa, Season - Varṣa and Sarad, Food and regimen: Sweet-Sour-Salty (Madhura-Amḷa-Lavaṇa) in taste (Rasa), Snigdha-Uṣṇa and associated Guṇas, Uṣṇa virya, Madhura-Amḷa in postdigestive effect (Vipaka), Moisture-promoting (Kḷedavardhana), occlusion and secretion promoting (Abhiṣyandi), and Vidahi in action (Karma). Prakṛti - Kapha-Pitta, Bala - Diminished, Agni - Diminished,
Prodromal symptoms	Exogenous edema (Sopha) and associated features
Pathogenesis	Primarily toxin induced (Viṣaja) Visarpa and resembles site-specific local pathologies

Pattern and aim of disease

When an individual who has travelled through any or all of the previously listed phases comes into contact with the virus, the immune system fails to fight it off, and the individual becomes a victim of its invasion. This invasion can occur by inhalation (vasa), ingestion (Bhojana), or

sparsa of infective material (Via of the Krimi). The infection then generates a local inflammation that is not always indicative of any Dosha. This inflammation quickly progresses into a lesion accompanied with necrosis of the tissue linked with exudation representing the implicated location. Association with a

specific Doshā occurs when that Doshā in circulation becomes concentrated at this site of inflammation as a result of the defect (Khavaigūya) caused therein. This process, which begins as an inflammation, rapidly spreads throughout the body, terminating in ulceration; necrosis is quite similar to cellulitis-like disorders.

When the condition affects the nose and paranasal sinuses, the symptoms match those of Duapratisyaya (chronic rhinitis) and Nasapaka (suppuration of the nasal region). Their placement in the lungs and intestines is comparable to that of Antarvidradhi (internal abscess). The substratum implicated should be used to determine illness stage, particularly severity (Vraavastu). The color of the ulcer, the type of the exudate, and the clinical symptoms stated in the ulcer diagnostic can all confirm this.

According to Ayurvedic nosology, ulcers with significant necrosis, exudation indicating deeper tissue involvement, and that have damaged the skull bone are untreatable.

Prevention and cure

Due to the fast-spreading nature and high mortality despite aggressive interventions, the role in treatment of the cases once occurred is very limited. Hence, efforts need to be concentrated on the preventive aspect. They can be deployed at two broad levels

- ❖ Protecting and strengthening the host (individual level)
 - ❖ Limiting the pathogen (community level)
- The most crucial of these is safeguarding and strengthening the host, because it is the most sustainable strategy. Protection will be provided by two methods: preventing exposure to the pathogen and making the body unfriendly to the

infection (mostly by covering the point of entry). Prophylaxis is required to maintain the body hostile to the infection, for which Ayurveda advocates a healthy lifestyle over overmedication. Food and routine are lifestyle foundations that must be systematized. The usage of bitter-tasting veggies is highly advised after thorough cleaning and washing. Cereals like wheat and barley; millets like Jowar, Ragi, and beans; and fruits like gooseberry and pomegranate are all advised.

Regimen

Regular scrub baths, steam inhalation, gargling with water boiled with antifungal medications, use of Au taila or other therapeutic oils such as nasal drops, adequate oral hygiene, and Yoga, Praayama, and other exercise that meets the individual's criteria should be followed. The seasonal regimen described in Autumn, as well as actions such as fumigation recommended in the rainy season, must be followed. Sleeping during the day, sedentary lifestyle, urge repression, gardening, and excessive outdoor activities are among the regimens to avoid, especially for a month following COVID infection. Drugs used for prevention must be pro-host (protective of the host's organs and bodily systems) and anti-pathogen (conducive in inhibiting the infection). Restoration of immunity and health of the tissues are to be ensured in immunocompromised individuals using Rasayana drugs.

Special pharmacological actions (Prabhavaḥ) are preferred: skin health promoting (Tvacya), blood-purifying (Raktasodhana), reducing moisture (Kṛedahara), antimicrobial (Kṛimihara), and immune-boosting (Rasayana).

Medicinal formulations

- ❖ Broad-spectrum antifungal action: Gaṇas - Triphala, Salasaradi/Asanadi, Nyagrodhadi, Aragvadhadi, Varuṇadi
 - ❖ Decoctions – Trayantyadi, Pancanimba.
 - ❖ Tablets: Arogyavardhini Vaṭi, Gandhaka Rasāyana, Triphalā guggulu, Kaiśora Guggulu.
 - ❖ Powders - Pancanimba, Nimbadi.
 - ❖ Fumigation over ulcer (Vraṇadhupana)
 - ❖ Nasal medication -Aṇutailaṃ, Ṣaḍbindutailaṃ.
 - ❖ Gargling - Haridra, Triphala, Tulasi.
- Bio-purificatory procedures - Fumigation is one of the most successful strategies in this regard. In practice, both herbal and chemical fumigation are extensively utilized. When fumigated for half an hour daily, Aparjita Dhuma was shown to successfully reduce the microbial load of *Aspergillus* species as well as numerous other bacterial and fungal species. Yavasarpadi dhuma churna was shown to be considerable and more efficient than formalin gas in lowering the load of *Candida albicans* and other germs such as *Staphylococcus aureus* when utilized for fumigation together with ghee for the sterilizing of operation theatre.

Conclusion

This review provides an understanding of mucormycosis from both the Ayurveda and Western biomedical perspectives. It also gives leads or directions in which future research works, both observational and experimental, may be oriented. Ayurveda has been proactive in the public health scenario of India for centuries and is still continuing to be. Mucormycosis, even when surgically treated, leaves severe sequelae that are incapacitating and disfiguring. There are an umpteen number of Ayurveda herbs and formulations that have preliminary

evidence to back their antifungal action. The role in early phases as standalone and adjuvant therapies and possibilities of them avoiding the need for surgical interventions would be of substantial service to humanity.

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