



Mucormycosis: Current Update in Pandemic COVID-19

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Background

Corona virus disease-2019 (COVID-19) is a pandemic entity caused by a novel corona virus (severe acute respiratory syndrome-coronavirus-2; SARS-CoV-2), which was firstly reported in Wuhan, Hubei territory in China on December 2019 [1,2]. SARS-CoV-2 is continuing to spread worldwide to till date with a high proportion of infected or affecting ≥ 10 million individuals globally [1]. Until now, there is no permanent cure for pandemic COVID-19 disease, though a variety of executive options have been evaluated and managed with systemic glucocorticoids for recovery of endurance rate of COVID-19 patients [2]. However, an array of complications reported during and post COVID-19 infection due to extensive use of glucocorticoids, which may lead to secondary fungal co-infection [1,2].

Recently, Garg, et al. [2] study a case report on COVID-19 associated with mucormycosis (MM) usually developed in 10-14 days after hospitalization and higher risk in diabetes mellitus, chronic obstructive pulmonary disease and immunocompromised patients. MM (formally known as Zygomycosis) is extremely scattering to immunocompromised patients, who have uncontrolled diabetic conditions. However, MM is an angioinvasive infection after *Aspergillus* and *Candida spp.* in humans, which is acute, extremely opportunistic and ubiquitous belonging to class Zygomycetes, i.e. 'pin molds' (formerly known as Phygomycetes). Zygomycetes quickly colonizes on nutriment rich carbohydrates medium like glucose as main energy source for its survival. Moreover, its spore's spreads

via oral, nasal and conjunctival mucosa by inhalation or ingestion of contaminated food materials [3]. Normally, MM is a non/sparsely septate fungus, which grow most often if individual have weakened immunity and resulting a high mortality rates exceeding of 60% with promising complications such as partial loss of neurological functions, blindness, clotting of brain or lung vessels, etc. [3,4].

Jestin, et al. [5] found to be a high incidence rate of 7.3% (per year) for MM infection during period of 2001 to 2010. Prevalence rate of MM is 0.14 cases per 1000 individual in developed countries, while its rate increase 80 times in developing countries like India [4]. Similarly, Millon, et al. [6] observed a prevalence and fatality rate of 7% and 9.3% in the United States and France, respectively during period 2000-2010. Nevertheless, Furbinger (1876) firstly investigated a patient who died with cancer and in whom right lung showed a hemorrhagic infarct with few sporangia of MM. The European Confederation of Medical Mycology and International Society of Human and Animal Mycology groups working on MM to constructed a registry in 2004 (www.zygomycosis.net) due to high mortality rate spreads by MM.

Several approaches have been developed, i.e. clinical signs/symptoms, microscopic viewing (wet mount, calcofluor white, periodic acid-schiff stain, gomori methenamine silver stain, FISH, immunohistochemistry), mycological cultures (API-ID50C/ID32C), serology, radiology, histopathology, etc. that can confirm diagnosis of invasive pin molds infection but these assays elusive, lack

variable sensitivities and specificities [7-9]. Aggressive nature of MM that delayed in diagnosis and treatment thus use of molecular approaches such as conventional PCR targeting mucorales 18S ribosomal DNA, spore coating protein homolog encoding genes (uniquely/universally present among all mucorales), RFLP, DNA sequencing, Real-time PCR (RT-PCR), matrix assisted laser desorption/ionization time-of-flight mass spectrometry (MALDI-TOF/MS) have been good utility for providing species identity of mucorales [8,10]. Moreover, serological tests including MALDI-TOF/MS, metabolomics and metagenomic shotgun sequencing are other advanced technologies may be helpful for MM diagnosis. The editorial note is to develop new molecular methods for mucormycetes *spp.* identification and proper treatment. Currently, most of the physician cum-researcher recommended a liposomal amphotericin-B with posaconazole and isavuconazole drugs are main choice for treatment of MM [9].

Conclusion

Over the past decade, a number of published studies on MM infection increased and reflects growing problems in highly immunocompromised patients. So, we need to improve for early diagnosis and understanding therapeutic management of MM by molecular methods. Moreover, diagnosis of MM could be possible using antigens/antibodies or DNA/RNA-based selection tools. Overall, we should focus on standardization/optimization of molecular techniques and their evaluation of merits incorporating into routine diagnostic algorithms.

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Conflicts of Interest

The authors declare that there are no conflicts of interest.

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