Fungal Infection Study Forum

www.fisftrust.org

Volume 6, Issue 2 May-August 2022

CORONAVIRUS DISEASE (COVID-19) ASSOCIATED MUCORMYCOSIS (CAM): WHAT DO WE KNOW SO FAR?

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Coronavirus disease (COVID-19) caused by a novel coronavirus, SARS-CoV-2, was declared a pandemic in January 2020. This pandemic has resulted in more than 600 million cases and 6 million deaths worldwide. The indirect social, economic and mental consequences have been unparalleled. Nearly eight months through the pandemic, a few reports of mucormycosis emerged.[1] These initial reports of mucormycosis were considered a part of infectious complications known to complicate viral illnesses like influenza. However, when more cases continued to be reported, the magnitude of the problem became evident. A multicenter study from India reported 187 cases of CAM across 16 centres in just three months (Sep-Dec 2020.[2] Mucormycosis was also reported from other countries, albeit much less than from India.[3]

Various immunomodulators have been used to suppress inflammation related to COVID-19. The increasing incidence of CAM was initially attributed to the rampant use and abuse of immunosuppressive drugs, especially glucocorticoids. Physicians noticed an unusual phenomenon as CAM cases escalated a few weeks after the start of the second and largest COVID-19 wave (March to May 2021) in India. Previously well, non-diabetic or well-controlled diabetics on home isolation for mild COVID-19 (who were neither exposed to glucocorticoids nor any other immunosuppressants) presented with CAM. Thus, the subsequent reports of CAM coinciding with the second wave of the COVID-19 pandemic challenged the existing views, and more research was undertaken. A consortium of ophthalmologists promptly collated their experience and published a report of 2,826 CAM patients encountered in five months.[4] Once a rare disease, mucormycosis quickly caught the attention of doctors, the public, and policymakers. From being a rare entity, mucormycosis became a notifiable disease in India, and hospitals had dedicated wards to manage this erstwhile rare disease. By May 2021, the country was battling the full-blown epidemic of mucormycosis, with almost 50,000 cases notified to the government (though the same portal cautioned that the actual numbers could be considerably higher than the reported numbers) amidst a devastating second wave of the COVID-19 pandemic.

A search for the cause of the CAM epidemic was urgently required. Several factors were proposed, including glucocorticoids, diabetes mellitus, zinc supplementation, altered iron metabolism, the induction of GRP78, the effect of Delta strain of SARS-CoV-2, and others. The exceedingly large number of cases from India masked the significant reports of

Message from the Editor

Dear all.

On behalf of FISF, it gives me great pleasure to welcome the delegates of the 21st Congress of the International Society for Human and Animal Mycology at New Delhi, India.

In this newsletter we first talk about the most unfortunate fungal disease event in the past two years and that is COVID associated Mucormycosis (CAM). The article by Chakrabarti et al discusses the possible reasons for CAM. The epidemic of CAM was associated with a serious shortage of amphotericin B which forced clinicians to use alternative drugs. Dr Soman discusses his experience with use of these drugs for CAM in the next article. Finally, there have been exciting developments in the domain of cryptococcal meningitis and these have been aptly summarized by Patel et al. We also have a short write up about FISF and the ISHAM program at a glance

We request all contribute to the Indian Fungal Registry (www.fungireg.in).

Editor

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CAM from several countries, including those from developed nations. For instance, a multicenter study from France reported a 1% prevalence of CAM among 565 critically ill COVID-19 patients.[5] Another study from Germany observed a prevalence as high as 0.6% among hospitalized COVID-19 subjects and 1.7% among COVID-19 subjects in the intensive care unit (ICU).[6] Notably, the estimates from the latter two studies were comparable to the data from India (0.27% among hospitalized COVID-19 patients and 1.6% among COVID-19 patients in the ICU) published in early 2021.[7] However, occurrence of CAM in patients with mild disease and those at home was unique to the Indian setting. The raging pandemic in India misled the lay public (who called the disease "black fungus") and the experts, who proposed several India-specific risk factors to explain the outbreak of mucormycosis, the prominent one being cattle dung burning and environmental dispersion of Mucorales spore. The high ecological burden of Mucorales in India, a known fact, was reconfirmed from a multicenter study across the country.[7] However, the theory of cattle dung burning as a major contributor to the CAM outbreak seemed unlikely from another aero-mycological study.[8]

Shortage of antifungal drugs, operating rooms running at full capacities, and ICUs struggling to manage the double whammy of COVID-19 and mucormycosis were commonplace during April-June 2021. Data from cohort and case-control studies consistently pointed towards the association between inappropriate use of glucocorticoids for COVID-19 and uncontrolled diabetes mellitus with CAM.[2,9] Zinc, elevated inflammatory markers (C-reactive protein), the pattern of mask usage, nasal washing during COVID-19, and elevated serum GRP78, were other possible associations explored in small case-control studies, remain to be proven in more extensive studies.[9-13] Despite a lack of apparent biological plausibility, a few factors, such as the use of oxygen from cylinders, were discussed yet not adequately evaluated. Indirect evidence supported the possible association of a few environmental factors (high spore burden in outdoor and indoor air, air-conditioning vents in hospitals, and ongoing construction activities) with the CAM outbreak.[7,14]

A campaign to curtail the abuse of glucocorticoids and an emphasis on glycemic control helped slow down the CAM epidemic. By July 2021, the epidemic had subsided, and few additional cases were reported. Though the judicious use of glucocorticoid therapy played a crucial role in controlling the CAM epidemic, the role of COVID-19 variants and their effect on host immunity was not evaluated. Genetic susceptibility among Indian subjects for mucormycosis was also not studied in the context of CAM. The resurgence of COVID-19 in early 2022 due to the Omicron variant was not associated with an increase in CAM. Milder disease and consequentially judicious use of COVID-19 therapies can be postulated as a reason for the lack of CAM cases. Yet, considering the compelling epidemiological evidence (few CAM cases during the first wave [alpha variant], a tremendous rise in the second wave [delta variant], and barely any reports of CAM during the recent omicron variant outbreak), the contribution of SARS-CoV-2 variants on Mucorales-specific immunity cannot be excluded.

A disease that was considered rare, remaining limited to the domain of few experts and specialists, received global attention. The increased awareness of the neglected fungal infection and more research on this serious illness can be considered the only silver lining of the recent CAM epidemic.[15] The studies so far have primarily focused on the role of host factors (diabetes mellitus, organ transplantation), environment (construction activities, indoor and outdoor spore burden of Mucorales, pattern of mask usage), and therapy offered for COVID-19 (glucocorticoids, zinc, and others). More research on the pathophysiology and treatment of mucormycosis is the need of the hour.

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EXPERIENCE OF TREATING CAM WITH POSACONAZOLE/ ISAVUCONAZOLE DURING AMPHOTERICIN B SHORTAGE

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Amphotericin B is considered the gold standard drug for management of mucormycosis (MM).[1] However during the surge of cases of COVID-19 associated Mucormycosis (CAM) in India during the second wave in 2021, unavailability of Amphotericin B (Ambisome) was a major problem.[2] However, this situation resulted in an opportunity to treat with Posaconazole (PCZ) or Isavuconazole (ISVCZ) without AmB. The role of these drugs has been the subject of clinical investigation in non-inferiority trials.[3] Whether there is an incremental benefit of AmB over Azoles and whether this extra benefit is counter balanced by the greater difficulties in AmB drug administration, toxicity, prolonged hospitalization and cost also needs further consideration.

We retrospectively analysed 28 consecutive cases of CAM during the second wave of COVID-19 in India in 2021.[4] The patients had various combinations of rhinosinusitis, palatal, orbital, skull base, cerebral and pulmonary involvement (Figure 1a, b) . Underlying co-morbidities were diabetes mellitus, hypertension, chronic kidney disease, receipt of steroids and other immunomodulators. There were 25 cases of Proven, 1 case of Probable and 2 cases of Possible CAM. Patients were given PCZ or ISVCZ based on factors like availability, affordability, site of infection or lack of treatment response. Some patients had received AmB elsewhere but had disease progression or some had briefly received additional AmB when it was available. Patients underwent surgical debridement in one or more sessions as was necessary and feasible, along with supportive treatment. They were monitored for interactions, adverse drug reactions (ADR) and clinical response. Therapeutic drug monitoring was used for PCZ in all cases and for ISVCZ for some cases. PCZ levels between 2.5-3 mg/L & ISVCZ levels between 5-7 mg/L were aimed for assurance of a therapeutic effect. Twenty one of these 28 patients improved and have been cured. They are off antifungal therapy and have remained well over a follow up period of 1 year. Six patients died, of which 2 deaths were attributable to Mucormycosis. These two patients had received treatment, the duration of which ranged from 4 to 24 days. One patient left the hospital & was presumed to have died. The overall cure/ survival rate of 75% in our series compares favourably with that reported in the literature.[3,5,6]

Although wider applicability of these results needs further investigation, the results do lead to speculation that treatment of Mucormycosis with PCZ or ISVCZ, without AmB, is possible.

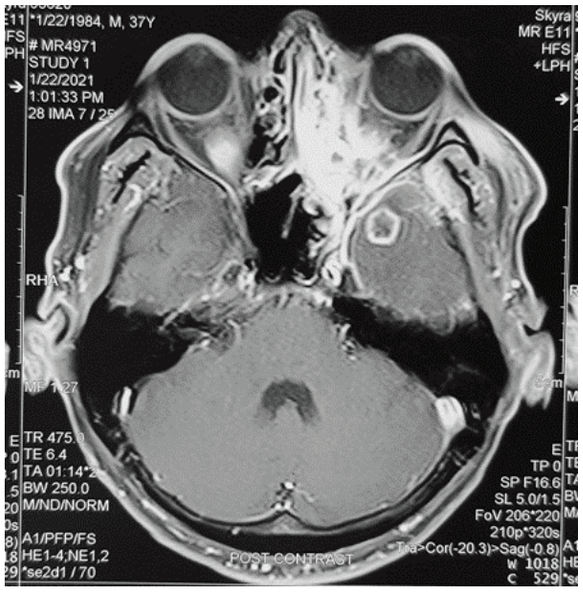

Figure 1a: MRI image of a patient with rhino orbito cerebral mucormycosis

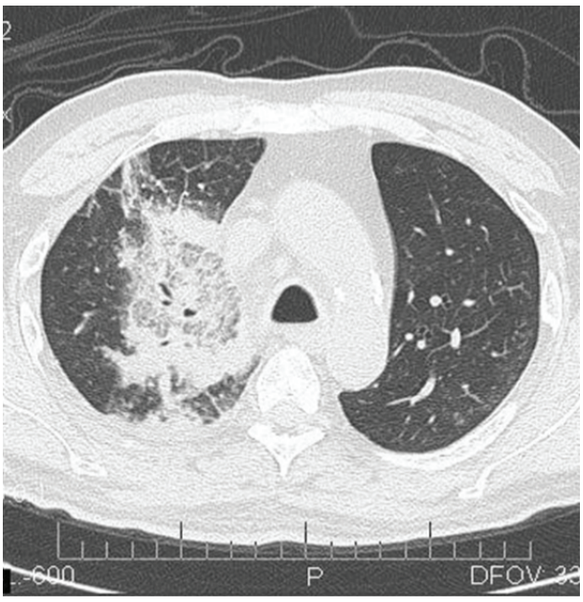

Figure 2: CT image of pulmonary mucormycosis with the reverse halo sign

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UPDATES ON DIAGNOSIS AND TREATMENT STRATEGIES FOR CRYPTOCOCCAL MENINGITIS

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With an estimated 135,900 deaths per year, cryptococcal meningitis (CM), the most prevalent form of infection with cryptococcal species, is a major OI in HIV-infected people in Africa. Clinical trials have shown that associated mortality is roughly 20% in regular clinical care settings whereas in areas with limited resources mortality rates are 40–50% or even higher.[1,2] The main reason for the high mortality rate is that CM therapy is difficult, expensive, and needs extended hospitalisation with demanding medical and nursing care. It is also not readily available in many parts of the world. The best results are usually obtained when amphotericin B (liposomal is recommended over deoxycholate) is infused for 1-2 weeks together with 5-FC. Substantial toxicities limit the use of Amphotericin B treatment, especially in African countries.

Recent developments in the diagnosis and treatment of cryptococcal infection will be discussed here in this article.

A: Diagnostic Updates:

1. Raising serum cryptococcal antigen (CrAg) testing bar from a CD4 cell count <100 to < 200/mm^3 in all newly diagnosed asymptomatic HIV patients.
2. CSF Lactate levels: a new prognostic factors for CM
3. Place of Antifungal drug Susceptibility testing (AST) for cryptococcal infection at baseline in first episodes of CM.

B: Management Updates:

1. Short course L-AmB Treatment for HIV associated CM
2. A mechanical way to reduce CSF Fungal burden: Lumber drainage & CSF filtration

Diagnostic updates

Serum CrAg screening

Wykowsky J et al. carried out serum CrAg screening in PLHA with a CD4 cell count of between 100-200 apart from those with CD4 ≤ 100/mm3.[3] This study discovered 2% CrAg positive in PLHA with a CD4 count of 100–200 cells/mm3. Both groups (CD4 ≤100) and between (100-200) were prospectively followed up for more than a year and evaluated for death or the development of CM. According to the study, compared to patients with CrAg -, mortality and/or CM were 6.3 times more common in CrAg+ patients with CD4 levels under 100 (95% CI: 2.7-14.6) and 10 times more common in CrAg+ patients with CD4 levels between 100 and 200 (95% CI: 2.2-45.3). The results of this study indicate that the threshold for screening for cryptococcal infection in newly diagnosed HIV should be raised from <100 to < 200/mm^3 This will aid us in identifying an additional 2% of people who are at risk, and effective treatment can lower mortality.[3]

CSF lactate level as a prognostic markers of disease severity and mortality in HIV associated CM.

For this study, data from participants of the adjuvant sertraline in the treatment of CM (ASTRO-CM) study who had baseline CSF lactate levels were used by Abbasi M et al.[4] The patients were placed into three groups according to their CSF lactate levels: 3.0, 3.1-5.0, and > 5.0 mmol/L. Participants with high CSF lactate, greater than 5.0 mmol/L, had significantly higher baseline CSF white cells (P =.007), lower baseline CSF glucose (P =.0003), high baseline CSF opening pressure (P =.03), Glasgow coma score 15 (P.0001), and baseline seizure (P =.0006). In the multivariate analysis: after adjusting for GCS, baseline seizures, OP, and quantitative CSF culture, high baseline CSF lactate was associated with a 3-fold higher risk of mortality at 2 weeks compared with CSF lactate ≤3.0 mmol/L, [aHR] = 3.41; 95% CI, 1.55–7.51; P = .0021. In addition to established poor prognostic markers like high opening pressure, high CSF CrAg titer > 1:1024, low CSF WBC count, and altered sensorium on presentation, clinicians can now also use baseline CSF lactate level for CM prognostic assessment.[4]

Baseline antifungal drug susceptibility testing (AST) results and treatment outcome in CM.

AST of baseline isolates of *C. neoformans* did not correlate with survival or mycological clearance, according to Connor LO et al.[5] The study used data from 299 trial participants who had signed up for study on combination antifungal therapy for cryptococcal meningitis.[5] Patients received induction treatment with either amphotericin monotherapy (1 mg/ kg/day for 4 weeks), amphotericin combined with flucytosine (100 mg/kg/day for 2 weeks), or amphotericin combined with fluconazole (400 mg twice daily for 2 weeks), followed by consolidation with fluconazole monotherapy (400 mg daily) until 10 weeks post randomisation. Viable fungal isolates were available for 276 patients for drug susceptibility testing. Authors didn't find evidence that antifungal susceptibility affected either the early (day 14) or late (6-month) hazard of death. Individual antifungal MIC and outcome data revealed no difference in patients with amphotericin B MIC (0.512 vs > 0.512). HR 1.01 (0.70-1.45) p=0.98, 5FC (MIC < 4.0 vs > 4.0), HR 0.59 (0.30-1.16), p= 0.13 and fluconazole MIC (<=8 vs > 8), HR 1.24 (0.82-1.86), p=0.31. The author concludes that routine AST has no place in clinical use in the first episode of CM.[6]

Management updates

Short course of L-AmB in the treatment of HIV associated CM

As the usual recommended international induction treatment for CM (2 weeks of Amphotericin B (L-AmB) + 5FC) is either not available or not tolerated by African patients, the region with the largest CM burden and death, shorter courses of amphotericin B therapy were investigated. The need for intravenous medication, laboratory monitoring for side effects, rigorous nursing care, and hospitalisation were additional downsides of amphotericin therapy. While shorter-course amphotericin B is associated with a more favourable side-effect profile with an acceptable rate of fungal clearance, this is mainly because of the long half-life of amphotericin B in brain tissue.[7] For the treatment of Kala-Azar, we have solid data on single, high-dose liposomal amphotericin treatments. ACTA research data showed that one week of amphotericin B therapy combined with 5 FC for two weeks of treatment was linked to the lowest mortality when compared to two weeks of amphotericin plus 5FC.[7] The all-oral group (Fluconazole with 5FC) did the second-best job in lowering

mortality. The L-AmB is added in a single high dose of 10 mg/kg on day 1 to the second best-performing ACTA regimens in the AMBISION study and compared with one week of the amphotericin B deoxycholate + 5FC regimen. According to a study, single-dose L-AmB given in combination with 5FC and fluconazole was not inferior to the current WHO-recommended treatment for HIV-associated CM at 10 weeks and was associated with fewer side effects. Early fungicidal efficacy differed by 0.017 log10 CFU per millilitre per day (95% CI, 0.001 to 0.036) between the two regimens. Single-dose L-AmB is now recommended by the WHO for the treatment of HIV-associated CM despite not being linked to a decrease in mortality due to two factors: non-inferiority and superior tolerability when compared to the comparator.[8]

Clinical trials with sustained-release 5FC in the treatment of CM are ongoing and results are not yet available, but it looks promising for patients as it can lessen the pill burden.

Reducing CSF fungal burden

One of the key components of treatment for the majority of invasive mycelial infections is de-bulking or surgical debridement, which has been associated with survival benefit when combined with appropriate antifungal therapy. Numerous clinical studies have shown that a quick reduction in fungal burden within two weeks is a key factor in CM survival.[9] A study has been conducted in CM to understand the benefits of mechanical removal of CSF cryptococcus on a patient's outcome.

Xiao-lei Xu recently compared lumber drainage (LD, n=40) and lumber puncture (LP, n=76) along with antifungal treatment in accordance with local treatment guidelines in 2022. The author discovered no difference in ICP normalisation, improvement in headache, or outcome, but a significant difference in CSF fungal clearance in the LD group (p=0.003).[10] We should carry out more studies of this type utilising the standard two-week L-AmB with 5-FC and WHO-recommended single high dose L-AmB and compare the results in the LP and LD groups as there was no significant clinical advantage reported in this study.

Neurapheresis is a research method for filtering CSF that involves inserting a dual-lumen catheter into a lumber region and guiding its tip up to the mid-thoracic level. CSF will pass through a filtration system, just like in haemodialysis, removing cryptococcus and pumping it back to mid-thoracic level with the same catheter. Automated pumps can be adjusted for desired circulation rate and also allow for the removal of desired volume in patients with raised ICP. In vitro, neurapheresis filtration provides a 5-log reduction in CSF fungal load, compared to the roughly 0.4 log/day reduction achieved by combined antifungal therapy with (L-AmB + 5-FC). Neurapheresis may also have other advantages, such as the ability to continuously monitor and regulate ICP, filter cytokines to lessen neuro-inflammation, and provide antifungal (L-Amb) intrathecally with even distribution in the subarachnoid space.[11]

Summary

In high-burden nations, increasing the CD4 200/mm^3 threshold in PLWHA for CrAg screening will enable the detection of an additional 2% of patients with crytptococcal antigemia. CSF lactate can now be utilised to assess the prognosis of CM patients. There does not seem to be any benefit in upfront testing for cryptococcal antifungal sensitivity in patients with first episode of CM. Using a single high-dose L-AmB treatment with fluconazole and flucytosine may emerge as an efficacious and safer regime for CM. New therapeutic techniques that reduce the fungus load through drainage or CSF filtration require more research. There is also need for greater research and optimum treatment strategies for non HIV CM.

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A FEW WORDS ABOUT FISF

Fungal Infections Study Forum (FISF) is a non-profitable scientific, educational and non-political organization specializing in the development of health, science and education in India relevant to the field of fungal diseases. Though the prevalence of fungal infections is very high in India, the discipline, Medical Mycology could not draw the adequate attention from doctors, administrators and funding agencies. Lack of awareness, inadequacy of mycology diagnostic facilities, and deficiency of training to manage fungal infections are the main challenges. Considering the above challenges sixteen doctors across India from different disciplines joined hands to develop the body, FISF in 2013 to reduce morbidity and mortality of fungal infections in India. The aim and objectives of FISF are:

- **Aims:** To undertake **epidemiological & clinical studies** maintaining the scientific integrity & validity, propose **country-specific management guidelines, & organize education activities.**
- **Objectives:**
  - To conduct **educational activities** including CMEs, Master Classes, Workshops independently or as part of any other scientific body
  - To undertake **epidemiological studies** on Invasive Fungal Infections (IFIs) independently or become part of other studies
  - To conduct studies on the **development or validation of diagnostic tests** for IFIs
  - To conduct **sound clinical studies** including trials for IFIs independently as investigator-initiated project or with Industry or Government or Institutional support
  - Development of **country specific management and other guidelines** for IFIs independent of any industry
  - To encourage and assist in the publication of **monographs and text** in the field of fungal infections

Over the last decade, the activities of FISF may be highlighted as below:

1. **Conferences and masterclasses** (Many international experts besides the national peer group participated in the activities)
   a. Mycology Master-class & 1st International conference in November 2014 at Kolkata
   b. Mycology Master-class & 2nd International conference in November 2016 at Mumbai
   c. Mycology Master-class & 3rd International conference in September 2018 at Delhi
   d. Mycology Master-class & 4th International Conference in April 2021 at Chennai (virtual)
   e. Regional conferences at Lucknow, Bhopal, Ahmedabad, Hyderabad, and Chandigarh.
   f. Many Industries supported one day CMEs across the country
   g. FISF joined hand with Indian Society for Medical Mycology (ISMM) to organize 21st Congress of International Society for Human and Animal Mycology
2. **Educational activities**
   a. Fungal Infection e-course (after running the course for three years, the course is being updated at present)
   b. FISF-Gilead Science training course for clinicians – 15 courses are proposed, 8 courses completed at Ahmedabad, Kolkata, Pune, Bhopal, Nagpur, Jaipur, Cochin, Ranchi; 7 more courses will be conducted in next six months
   c. FISF publishes three academic newsletters every year. The newsletters contain updates, insights in the diagnosis and management of fungal infection, challenging cases, quiz providing photograph of cases etc.
3. **Research**
   a. FISF completed two research projects 'Invasive mould infections in Indian ICUs- descriptive epidemiology, management and outcome' and 'Multi-centre observational study on epidemiology, treatment and outcome of mucormycosis in India'
   b. Published four papers in reputed International journals
   c. During COVID-19 associated mucormycosis outbreak, they provided the recommendation with Indian Council of Medical Research to manage the disease, and national recommendation on antifungal therapy when drug availability is limited, which is published in 'Mycoses' along with ISHAM and ECMM. As the diagnosis and management of pulmonary mucormycosis was difficult during the outbreak, FISF conducted Delphi study with Academy of Pulmonary Sciences, India, and published in Lancet Infectious Disease 'Definition, diagnosis, and management of COVID-19 associated pulmonary mucormycosis; Delphi consensus statement from Fungal Infection Study Forum and Academy of Pulmonary Sciences, India'
   d. FISF has launched **'Fungal Registry of India'** for 'aspergillosis', 'mucormycosis', and 'endemic mycoses and rare mycelial fungal infections' since last year.

We understand our activity is not adequate to meet the enormous requirement in this field, but we are confident to reach the goal, as administrators and medical fraternity have realized the importance fungal infections after *Candida auris* and mucormycosis outbreaks in this country. Large numbers of doctors are taking interest in this field. You are welcome to join us at FISF. You may see us more at our active website http://www.fisftrust.org/

ISHAM 2022 - Program at a Glance

20-24 September, 2022 • Delhi

September 20, 2022						
08.00 AM	open					
08.30 AM -04.30 PM	YISHAM symposium	Infectious Disease CME Workshop		Critical Care CME Workshop	Laboratory Practices CME Workshop	
08.30 AM	Registration ISHAM congress open					
05.00-07.00 PM	Inauguration					
19.00-21.00	Welcome reception including snacks					
September 21, 2022						
08.00-9.30 AM	General Assembly					
09.30-10.30 AM	Presidential oration Speaker: John Perfect, USA Chair: Arunaloke Chakrabarti, India					
11.00 AM -12.30 PM	Parallel session 1	S1.1 Controversies in the clinical management of invasive candidiasis in critically ill patients	S1.2 Animal Mycoses	S1.3 Malassezia: genetics, genomics, and biology	S1.4 Fungal infections in Asia, bringing it out of the dark	S1.5 Mycotic Keratitis
12.30-14.00	Lunch and Poster session 1					
12.30-14.00	Sponsored symposium 1: Pragmatic approach in management of invasive mold infection (IMI)					
14.00-14:450	P1 Recent Developments of the ECMM-ISHAM-ASM Global Guideline Program					
15.00-16.30	Parallel session 2	S2.1 Update on Mucor-mycosis	S2.2 Histoplasmosis & Talaromycosis	S2.3 Novel Diagnostic tools for Invasive Mold infection :	S2.4 Veterinary Mycology Research	S2.5 Rare Yeasts
16.45-18.15	Parallel session 3	S3.1 Neglected implantation mycoses	S3.2 Challenging clinical cases	S3.3 Innate immune responses to pathogenic fungi	S3.4 Free oral paper session	S3.5 Environmental Exposure - Risk for Human Fungal Disease
18.15-19.00	Plenary session 2	P2 Evolution of mating systems and genome organization in budding yeasts				
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8.00-8.45	Meet the expert session	M1.1 Diagnostic Rounds Interactive session for diagnosis of emerging and re-emerging fungal infections	M1.2 Human Pythiosis	M1.3 Standardization of diagnostic mycology laboratories		
09.00-09:45	Plenary session 3	P3 Progress in fungal diagnostics: the pros and cons				
10.30-12.00	Parallel session 4	S4.1 Treatment of Rare Mould Infections in 2021: The role of new and old antifungals	S4.2 Advances in Diagnosis of Invasive fungal infection	S4.3 Emergent species of the Candida genus	S4.4 International Histo-plasmosis Advocacy group (IHAG)	S4.5 Mycetoma Clinical Trial on fosravuconazole treatment in eumycetoma– Top Line Results
12.00-14.00	Lunch and Poster session 2					
12.30-14.00	Sponsored symposium 2: Importance of Turn Around Time In Fungal Diagnostics					
14.00-14.45	Plenary session 4	P4 COVID-19 associated fungal infections				
15.00-16.30	Parallel session 5	S5.1 Antifungal Resistance	S5.2 The threat of invasive fungal infections: the first WHO list of fungal pathogens of public health importance	S5.3 Cellular pleomorphism and fungal virulence	S5.4 Free oral paper session	S5.5 Genomic Epidemiology of Fungal Infections
16.45-18.15	Parallel session 6	S6.1 Antifungal Prophylaxis in Children with Cancer and HSCT	S6.2 Resurgence of dermato-phytic infections		S6.4 One health approach for endemic mycoes in the Americas	S6.5 Efforts of improving the management of mycetoma: working towards the 2030 goals
18.15-19.00	Plenary session 5	P5 Advances in the field of aspergillosis				
19.00	Young ISHAM party					

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8.00-8.45	Meet the expert session 2	M2.1 Point of care test	2.2 Allergic fungal lung diseases			
9.00-10.00	Plenary session 6	P6 New azoles in management of invasive mould infections				
10.30-12.00	Parallel session 7	S7.1 Update in management of fungal infection in adult haematology	S7.2 More than just candidemia: Clinical aspects, diagnosis and treatment, and pathogenesis of deep-seated candidiasis	S7.3 Emergent theories on pathogenic fungal dispersal around the globe	S7.4 Pathgenesis and host defense:	S7.5 MMCR case report session
12.00-14.00	Lunch and Poster session 3					
12.30-13.30	Pipeline session 12:30 Olorofim – first of a novel class of antifungals (F2G) 12:45 Opelconazole (PC945): A Novel Inhaled Azole in Late-Stage Clinical Development for Invasive Pulmonary Aspergillosis 13:00 Scynexis - Ibrexafungerp: First in a New Class Triterpenoid Antifungal in Development for Treatment of Invasive Fungal Infections and Vulvovaginal Candidiasis					
14.00-15.00	Plenary session 7- P7 Banging our head against the (fungal) wall					
15.00-16.30	Parallel sessions 8	S8.1 Tackling Candida auris in resource-limited settings	S8.2 What is new in pediatric mycology?	S8.3 How the Fungal Cell Wall Glycan Can Modulate the Immune Response?	S8.4 Veterinary Mycology and One Health Working Group Business Meeting	S8.5 Genotyping of Cryptococcus neoformans and C. gattii
16.45-18.15	Parallel session 9	S9.1 Chronic Pulmonary Aspergillosis - where do we stand?	S9.2 Azole resistance in Aspergillus fumiagatus: how hot is your hotspot?	S9.3 Drug resistance in emerging pathogenic fungi Chairs:	S9.4 Free oral paper session	S9.5 Malassezia: pathogenesis and disease
19:30	Congress Dinner					
September 24, 2022						
8.00-8.45	Meet the expert sessions 3	M3.1 Common errors in clinical mycology	M3.2 Common errors in Medical Mycology laboratory			
9.00-10.00	Plenary session 8	P8 Challenges in the diagnosis & management of fungal infections in developing countries				
10.30-12.00	Parallel session 10	S10.1 Antifungal dosing in children and adolescents	S10.2 Fungal Infections in Transplant Patients	S10.3 The mycobiome characterization: future perspectives or just a trend?	S10.4 Emerging antifungal resistant fungi	S10.5 Fungal respiratory infections in Cystic Fibrosis
12.00-12.30	Closing ceremony					