Results. A total of 61 patients with proven mucormycosis were analyzed. The primary site of infection was as follows; lung (n = 38, 62.3%), rhino-sinus (n = 21, 34.4%), and orbito-cerebral (n = 15, 24.6%). Based on sterile culture results, 4 patients (6.6%) had the evidence of co-infection with other fungi including *Candida* species (from 3 cases; *C. albicans* from 1, *C. glabrata* from 1 and *C. krusei* from 1), *A. flavus* (1), and *F. solani* (1), and 23 patients (37.7%) had the evidence of co-infection with bacteria including *E. faecium* (VRE) (8), *P. aeruginosa* (5),coagulase-negative staphylococci (5), methicillin-susceptible *S. aureus* (4) and others. Based on non-sterile culture results, 10 patients (16.4%) had the evidence of co-infection with fungi other than mucormycosis including *Aspergillus* species (5, *A. fumigatus* from 1, *Aspergillus* not *fumigatus* from 1 and *A. oryzae* from 1), *Candida* species (5, *C. albicans* from 2, *C. tropicalis* from 2 and *C. glabrata* from 1), *Penicillium* species (1), *S. cerevisiae* (1) and *P. jirovecii* (1), and 24 patients (39.3%) had evidence of bacterial co-infection including *S. maltophilia* (5), methicillin-resistant *S. aureus* (5), *E. faecium* (VSE) (3), *K. pneumonia* (3), *P. aeruginosa* (3), and others.

Conclusion. Bacterial or fungal co-infections appear to frequently occur as appreciated before in patients with mucormycosis. These data provide us important information to select empirical antifungal and antibacterial agents.

Table 1. Clinical Characteristics and Culture Positivity in Proven Mucormycosis Patients

Variable		Total (n = 61)
Age, mean years ± SD		59.2 ± 12.9
Male sex		33 (54.1)
Positive galactomannan assay	Serum	22/28 (78.6)
	Bronchoalveolar lavage fluid	10/16 (62.5)
	Both	4/16 (25.0)
Underlying conditions	DM	17 (27.9)
	Solid organ transplantation	11 (18.0)
	Hematopoietic stem cell transplantation	10 (16.4)
	Hematologic malignancy	7 (11.5)
	Solid cancer	8 (13.1)
	Liver cirrhosis	28 (45.9)
	Neutropenia	8 (13.1)
	Chronic kidney diseases	11 (18.0)
	ESRD on dialysis	0 (0)
	Autoimmune diseases with immunosuppressive agents	3 (4.9)
Infected organs	Pulmonary	38 (62.3)
	Rhino-sinus	21 (34.4)
	Orbito-cerebral	15 (24.6)
	Gastrointestinal	8 (13.1)
	Skin	2 (3.3)
	Etc. (bone, thyroid, tongue, etc.)	5 (8.2)
Positive culture results for mucormycosis	Sterile sites[a]	12 (19.7)
	Rhizopous species	7
	Mucor species	3
	Absidia species	1
	Cunninghamella species	1
	Non-sterile sites[b]	4 (6.6)
	Rhizopous species	2
	Mucor species	1
	Cunninghamella species	1
Patients with other pathogens confirmed from sterile sites[a]	Fungi other than mucormycosis	4 (6.6)
	Bacteria and others	23 (37.7)
Patients with other pathogens confirmed from non-sterile sites[b]	Fungi other than mucormycosis	10 (16.4)
	Bacteria and others	24 (39.3)

Data are given as mean ± SD or as number (percentage).
[a]Including blood (plasma, serum), CSF, specimen obtained by a sterile procedure and pleural fluid
[b]Including sputum, bronchoalveolar lavage fluid, cranial sinus cavity specimen, urine and other specimen (pus culture, ascites, etc.)

Table 2. Co-infecting Organisms Isolated from Sterile and Non-sterile Specimen in Proven Mucormycosis Patient

Pathogen	Sterile culture[a]	Non-sterile culture[b]	Total (n = 61)
Fungi other than mucormycosis			
Aspergillus species			
Aspergillus flavus	1	0	1 (1.6)
Aspergillus fumigatus	0	3	3 (4.9)
Aspergillus not *fumigatus*	0	1	1 (1.6)
Aspergillus oryzae	0	1	1 (1.6)
Fusarium solani	1	0	1 (1.6)
Penicillium species	0	1	1 (1.6)
Candida species			
Candida albicans	1	2	3 (4.9)
Candida tropicalis	0	2	2 (3.3)
Candida glabrata	1	1	2 (3.3)
Candida krusei	1	0	1 (1.6)
Saccharomyces cerevisiae	0	1	1 (1.6)
Pneumocystis jirovecii	0	1	1 (1.6)
Bacteria			
Viridans streptococci	1	0	1 (1.6)
Coagulase-negative staphylococci	5	2	7 (11.5)
Methicillin-susceptible *Staphylococcus aureus*	4	0	4 (6.6)
Methicillin-resistant *Staphylococcus aureus*	1	5	6 (9.8)
Corynebacterium Striatum	1	0	1 (1.6)
Enterococcus faecalis	0	1	1 (1.6)
Enterococcus faecium (VSE)	0	3	3 (1.6)
Enterococcus faecium (VRE)	8	2	10 (16.4)
Corynebacterium Striatum	0	1	1 (1.6)
Escherichia coli	0	1	1 (1.6)
Klebsiella pneumoniae	0	3	3 (4.9)
Klebsiella pneumoniae (CRE)	1	2	3 (4.9)
Klebsiella aerogenes	1	1	1 (1.6)
Enterobacter cloacae	1	0	1 (1.6)
Pseudomonas aeruginosa	5	3	8 (13.1)
Acinetobacter baumannii	0	2	2 (3.3)
Acinetobacter lwoffii	0	1	1 (1.6)
Serratia marvescens	1	1	2 (3.3)
Stenotrophomonas maltophilia	2	5	7 (11.5)
Lactobacillus species	0	1	1 (1.6)
Others	0	2	2 (3.3)

Data are given as number (percentage).
[a]Including blood (plasma, serum), CSF, specimen obtained by a sterile procedure and pleural fluid
[b]Including sputum, bronchoalveolar lavage fluid, cranial sinus cavity specimen, urine and other specimen (pus culture, ascites, etc.)

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1704. *Geotrichum* spp. Invasive Infection: Experience From a Third-Level Referral Center in Mexico

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Background. *Geotrichum spp* has been recognized as an emergent pathogen that causes invasive infection in immunosuppressed hosts. There is no data in Latin America about invasive *Geotrichum* spp. infections. Our objective was to describe the epidemiology, clinical characteristics, and outcomes of patients with this infection.

Methods. We conducted a retrospective survey from 2001 to 2018, of all the *Geotrichum* spp. isolated from clinical samples at our institution. Data on demographic, clinical, laboratory findings, and imaging studies were obtained from medical records. All cases classified as proven or probable invasive fungal infections (IFI) according to the EORTC/MSG criteria were included. Isolates with unavailable clinical information were excluded. Descriptive analysis was made.

Results. We found 18 patients with a proven/probable *Geotrichum* spp. IFI. The mean age was 48.5 years and 55.5% were male. The most common predisposing condition was hematological malignancy (55.5%), autoimmune diseases (22.2%) and HIV, chronic granulomatous disease, and solid-organ malignancy in 1 case, respectively. Fifteen (83.3%) received immunosuppressors (cancer chemotherapy or steroids); 27.7% had neutropenia at the time of diagnosis. The most common clinical syndromes were lower respiratory tract infection and persistent fever (83.3%). Chest abnormalities were present in 15/16 CT scans, pulmonary nodules were the most common finding (62.5%). *Geotrichum* spp. was isolated from bronchoalveolar lavage, 77.7%; blood culture, 22.2%; and peritoneal dyalisis fluid, 5.6%. Seven patients were coinfected with other pathogens: 4 *Aspergillus* spp., 1 *H. parainfluenzae,* 1 *P. aeruginosa,* and 1 *E. coli.* Fifteen patients received antifungal treatment: 7 amphotericin B, 8 voriconazole, and 1 itraconazole. Among survivors (11), 72.7% received antifungal therapy at discharge: 4 voriconazole and 4 itraconazole. Three patients did not receive any antifungal: 1 was diagnosed postmortem and 2 were considered colonization (both were alive at 30 days). Overall mortality was 38.8%.

Conclusion. Eighteen cases of *Geotrichum* spp. were found. The majority had lower respiratory tract infection. Despite antifungal therapy 38.8% died. *Geotrichum* spp. should be recognized as an emerging pathogen in immunosuppressed hosts.

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1705. Clinical Characteristics and Outcomes of Cryptococcosis in a Tertiary Care Center in Kentucky, 2005 to 2017

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Background. Cryptococcosis is an invasive fungal infection that causes pneumonia and extrapulmonary infection. This study explores its presentations, diagnostic tests, and outcome in different groups over a 12-year period at an academic medical center.

Methods. This was a retrospective study of the patients treated at University of Kentucky HealthCare from October 16, 2005 to October 15, 2017. Inclusion criteria were positive cryptococcal antigen (Ag), positive culture, or presence of yeast morphologically consistent with *Cryptococcus* on cyto- or histopathology. Patients were divided into HIV-infected, solid-organ transplant (SOT) recipients, and non-HIV/non-transplant groups. Cryptococcal meningitis comprised of either positive CSF Ag, culture, cytology or histopathology.

Results. A total of 114 patients were identified; 23 HIV-infected, 11 SOT recipients and 80 non-HIV/non-transplant patients (Table 1). *Cryptococcus neoformans* was the most common yeast isolated (91.8%). Cryptococcal meningitis was seen in 56% of total patients whereas 27% had isolated cryptococcal pneumonia ($P < 0.01$). Blood cultures and serum Ag were positive in 34% and 70%, respectively. Only 8.7% of HIV-infected patients had isolated pulmonary cryptococcosis compared with 36.4% in SOT recipients ($P < 0.01$). In patients with cryptococcal meningitis, abnormal CSF cell count, protein, or glucose was noted in 85.3%; India ink was positive in 61.3% and CSF culture was positive in 73.4% (Table 2, Figure 1). CSF cryptococcal Ag was detected in 95.6% cases if CSF cultures were positive, whereas serum Ag was positive in only 85.1% of meningitis cases. Mortality was seen in 48.6% (17/35) of patients with cirrhosis/liver disease, compared with 21.5% (17/79) of non-cirrhosis/liver disease ($P = 0.003$). Transplant group had 54.5% mortality compared with 26.1% in HIV group ($P = 0.016$).

Conclusion. Cryptococcal meningitis was the most common presentation for cryptococcal disease in all three groups. Isolated pulmonary disease was least common in the HIV-infected group. Inpatient mortality rate was higher in patients with cirrhosis/liver disease and transplant group compared with those without cirrhosis/liver disease and HIV group, respectively. It is imperative to rule out meningitis in immunosuppressed patients with cryptococcal pneumonia.

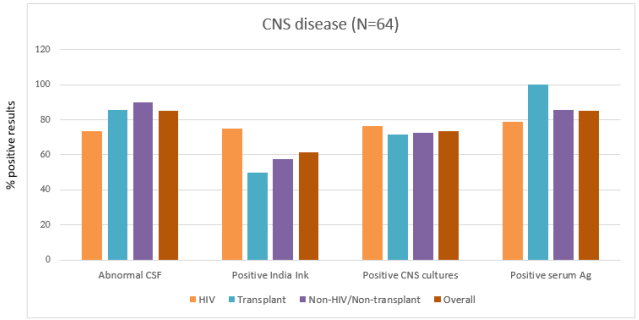
Table 1: Cryptococcal presentation and infectious disease testing by patient risk groups

	HIV-infected patients	Solid organ Transplant recipients	Non-HIV/non-Transplant patients	Total	p-value
Meningitis (%)	17/23 (73.9)	7/11 (63.6)	40/80 (50)	64/114 (56.1)	0.11
Isolated pulmonary disease (%)	2/23 (8.7)	4/11 (36.4)	25/80 (31.3)	31/114 (27.2)	< 0.01
Antigenemia or fungemia without meningitis or pneumonia (%)	4/23 (17.4)	0/11 (0)	15/80 (18.8)	19/114 (16.7)	0.37
Cirrhosis/liver disease (%)	4/23 (17.4)	4/11 (36.4)	27/80 (33.8)	35/114 (30.7)	0.33
Positive blood culture (%)	11/21 (52.4)	3/11 (27.3)	22/74 (29.7)	36/106 (34)	0.15
Positive serum Ag (%)	16/20 (80)	7/9 (77.8)	40/61 (65.6)	63/90 (70)	0.46
Inpatient mortality (%)	6/23 (26.1)	6/11 (54.5)	22/80 (27.5)	34/114 (29.8)	0.17

Table 2: Results of diagnostic testing for cryptococcal meningitis in three patient groups

	HIV-infected patients	Solid organ Transplant recipients	Non-HIV/non-Transplant patients	Total
Abnormal CSF WBC, protein, and/or glucose (%)	11/15 (73.3)	6/7 (85.7)	35/39 (89.7)	52/61 (85.3)
Positive India Ink (%)	12/16 (75)	3/6 (50)	23/40 (57.5)	38/62 (61.3)
Positive CNS cultures (%)	13/17 (76.5)	5/7 (71.4)	29/40 (72.5)	47/64 (73.4)
Positive serum Ag (%)	11/14 (78.6)	5/5 (100)	24/28 (85.7)	40/47 (85.1)
Positive CSF Ag if culture is also positive (%)	12/12 (100)	3/4 (75)	28/29 (96.5)	43/45 (95.6)

Figure 1: Percent positive test results by patient group for cryptococcal meningitis



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1706. Use of Management Bundles as a Checklist for Candidemia: Impact of Compliance on Clinical Outcomes in a Multicenter Study in Japan

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Background. We previously developed management bundles for candidemia and beneficial effects on clinical outcomes were shown in compliant patients (JAC 2015). However, there is a risk for bias because some elements cannot be achieved in patients who have an early death.

Methods. Patients with candidemia who were treated at six medical centers between 2015 and 2017 were prospectively evaluated. Bundle elements consisted of removal of central venous catheters within 24 hours, initial appropriate selection and dosing of antifungals, an ophthalmological examination, follow-up blood cultures, consideration of alternative antifungals on the 3rd to 5th days, and at least 2 weeks of therapy. To exclude bias by early death, we investigated the clinical results in patients who survived ≥2 weeks.

Results. Among 221 patients with candidemia, 190 patients were analyzed (31 patients were excluded because of early death). Clinical success and the 28-day mortality rate were 77.4% (171/221) and 22.2% (49/221) in all patients with candidemia and 88.9% (167/190) and 9.5% (18/190) in eligible patients, respectively. Compliance in achieving all bundle elements was accomplished in 67.9% of eligible patients. In multivariate analysis, compliance with the bundles was an independent factor for 28-day mortality (4.7% vs. 19.7%, odds ratio 0.19, 95% confidence interval 0.05–0.63). However, compliance did not affect clinical success (92.2% vs. 82.0%, odds ratio 2.13, 95% CI 0.77–5.86). Non-*Candida albicans*, disseminated candidiasis, and total parenteral nutrition were independent factors for poor clinical success. Severe severity and total parenteral nutrition were independent factors for 28-day mortality.

Conclusion. With prospective use of bundles as a checklist in patients with candidemia, compliance of bundles has a beneficial effect on clinical outcomes. This research was supported by AMED (JP18fk0108045).

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1707. Invasive Pulmonary Aspergillosis in Patients with Severe Fever with Thrombocytopenia Syndrome

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Background. Severe fever with thrombocytopenia syndrome (SFTS) is an emerging tick-borne disease often accompanied by immune catastrophic course and subsequent fatal outcome. More than 90% of patients with SFTS had leukopenia and about one-third of those need the admission of intensive care unit (ICU) during the hospital course. So, there has been growing concern about the complications such as invasive pulmonary aspergillosis (IPA) in critical SFTS patients. We thus investigate the incidence and clinical characteristics of IPA in patients with SFTS.

Methods. All patients who were confirmed as SFTS in a tertiary care hospital, Seoul, South Korea, between January 2013 and October 2018 were enrolled. The modified AspICU algorithm was used to identify cases of putative invasive pulmonary aspergillosis (PIPA) and discriminate these invasive diseases from colonization.

Results. Of the 45 PCR-confirmed SFTS patients, 16 (36%) received ICU care. Of these 16 patients, 9 (56%) developed PIPA during hospitalization. The median duration from admission to the first evidence of PIPA was 8 days (range, 2–11 days). None of the PIPA cases met the revised EORTC/MSG criterion. Septic shock and corticosteroid administration preceded more frequently in PIPA group than non-PIPA group (100% vs. 19%, $P < 0.0001$ and 67% vs. 14%, $P = 0.003$, respectively). Patients complicated by PIPA showed significantly higher mortality than non-PIPA patients (44% vs. 8%, $P = 0.048$ by log-rank test). Mortality was lower in patients with PIPA who received antifungal treatment (17% [1/6]) than in those with PIPA who did not (100% [3/3]) (log-rank test, $P = 0.002$).

Conclusion. More than half of patients with SFTS in ICU were complicated by IPA during early hospital course. Cautious scrutiny for IPA in patients with SFTS followed by early appropriate antifungal therapy for IPA is needed.

Table 1. Demographic and clinical characteristics of SFTS patients

Variables	Total (n=45)	PIPA (n=9)	non-PIPA (n=36)	*P* value
Age, years, mean ± SD	61.7±9.1	62.9±7.9	61.4±9.5	0.589
Male	27 (60.0)	5 (55.6)	22 (61.1)	1.000
Region				
Seoul and metro	20 (44.4)	1 (11.1)	19 (52.8)	0.030
Others	25 (55.6)	8 (88.9)	17 (47.2)	
Season (months)				
Spring-summer (3-8)	21 (46.7)	7 (77.8)	14 (38.9)	0.110
Fall (9-11)	23 (51.1)	2 (22.2)	21 (58.3)	
Winter (12-2)	1 (2.2)	0 (0)	1 (2.8)	
Underlying diseases				
Previously healthy	26 (57.8)	4 (44.4)	22 (61.1)	0.461
Diabetes	11 (24.4)	4 (44.4)	7 (19.4)	0.190
Lung disease	6 (13.3)	2 (22.2)	4 (11.1)	0.583
Chronic kidney disease	0 (0)	0 (0)	0 (0)	NS
Liver cirrhosis	1 (2.2)	0 (0)	1 (2.8)	1.000
Cardiovascular disease	8 (17.8)	1 (11.1)	7 (19.4)	1.000
Autoimmune disease	3 (6.7)	1 (11.1)	2 (5.6)	0.497
Solid tumor	2 (4.4)	0 (0)	2 (5.6)	1.000
Hematologic malignancy	0 (0)	0 (0)	0 (0)	NS
Transplantation	0 (0)	0 (0)	0 (0)	NS
Human immunodeficiency virus	0 (0)	0 (0)	0 (0)	NS
Immunosuppressant and steroid user	0 (0)	0 (0)	0 (0)	NS
Symptoms and signs at initial presentation				
Fever	45 (100)	9 (100)	36 (100)	NS
Rash	8 (17.8)	3 (33.3)	5 (13.9)	0.326
Bleeding	6 (13.3)	1 (11.1)	5 (13.9)	1.000
Myalgia	23 (51.1)	5 (55.6)	18 (50.0)	1.000
Anorexia	30 (66.7)	5 (55.6)	25 (69.4)	0.454
Lymphadenopathy	10 (22.2)	2 (22.2)	8 (22.2)	1.000
Nausea or vomiting	21 (46.7)	3 (33.3)	18 (50.0)	0.469
Abdominal pain	9 (20.0)	2 (22.2)	7 (19.4)	1.000
Diarrhea	21 (46.7)	3 (33.3)	18 (50.0)	0.469
Cough/sputum/dyspnea	14 (31.1)	4 (44.4)	10 (27.8)	0.428
Headache	15 (33.3)	4 (44.4)	11 (30.6)	0.454
Altered mental status	22 (48.9)	9 (100)	13 (36.1)	0.001
Eschar	12 (26.7)	3 (33.3)	9 (25.0)	0.682

Values are n (%) unless otherwise indicated. Abbreviations: PIPA, putative invasive pulmonary aspergillosis; SD, standard deviation; NS, not significant.