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**Session:** 56. Fungal Disease: Management and Outcomes
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***Background.*** Distinguishing aspergillosis from mucormycosis is clinically important as different antifungal agents are required. However, the sensitivity of fungal culture is suboptimal and histomorphologic diagnosis is not always accurate due to morphologic similarities. We investigated the diagnostic performance of immunohistochemistry (IHC) test for diagnosis of aspergillosis and mucormycosis.

***Methods.*** Patients who met the criteria for mycologically proven aspergillosis or mucormycosis and in whom formalin-fixed, paraffin-embedded tissues were available were enrolled at a tertiary hospital from January 1992 to October 2017. Mycologically proven invasive fungal infections were defined as there were the histologic evidence of tissue invasion of hyphae and the recovery of *Aspergillus* species or agents of mucormycosis (*Rhizopus* spp., *Cunninghamella* spp., *Apophysomyces*spp., *Saksenaea* spp., *Absidia* spp., *Mucor* spp.) by culture from sterile specimens. Anti-*Aspergillus* mouse monoclonal antibody (1:50; clone WF-AF-1; LSBio, WA, USA) and anti-*Rhizopus arrhizus* mouse monoclonal antibody (1:100; clone WSSA-RA-1; LSBio, WA, USA) were used for IHC test, and we evaluated the diagnostic performance of IHC test using sensitivity and specificity.

***Results.*** A total of 32 invasive fungal infection including 12 proven mucormycosis and 20 proven aspergillosis were analyzed. The fungal species from sterile sites and diagnostic performance of IHC test for these 30 patients were shown in Table 1.

***Conclusion.*** The IHC test seems to be useful in compensating the limitations of histomorphologic diagnosis in distinguishing between aspergillosis and mucormycosis.

**Keywords.** Aspergillosis; Mucormycosis; Histomorphology; Immunohistochemistry

**Table 1:** Diagnostic Performance of Mucormycosis and Aspergillosis Immunohistochemistry Tests in Proven Mucormycosis and Proven *Aspergillosis*

| IHC Test Result | Proven Mucormycosis, No. of Cases ($n$ = 12) | Proven Aspergillosis, No. of Cases ($n$ = 20) | Diagnostic Performance % (95% CI) |
|---|---|---|---|
| Mucormycosis | | | |
| Positive | 12 | 0 | Sensitivity: 100 (70–100) |
| Negative | 0 | 0 | Specificity: 100 (80–100) |
| *Aspergillosis* | | | |
| Positive | 0 | 18 | Sensitivity: 90 (67–98) |
| Negative | 0 | 2 | Specificity: 100 (70–100) |

Abbreviations: CI, confidence interval; IHC, immunohistochemistry.

***Disclosures.*** **S. H. Kim**, the Korea Health Technology R&D Project through the Korea Health Industry Development Institute (KHIDI): Investigator, Grant recipient.

### 420. A Rapid PCR Assay Detects Fungemia Due to Mixed *Candida* Species That Is Missed by the Clinical Microbiology Laboratory

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**Session:** 56. Fungal Disease: Management and Outcomes
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***Background.*** As identified by blood cultures, ~4% of candidemia is caused by mixed *Candida* spp. Studies of PCR-based diagnostics, however, suggest that ≥ 2 spp. can be detected in 6%–36% of candidemia. Our objective was to use molecular methods to determine rates of mixed *Candida* spp. fungemia at our center.

***Methods.*** We devised a rapid, PCR assay that identifies *Candida* spp. by amplifying *ACT1* and accounting for differences in intron sizes. We extracted total DNA from blood culture bottles from 15 patients, from which *Candida* had been recovered by the clinical microbiology laboratory.

***Results.*** Using standard laboratory protocols and MALDI-TOF, candidemia was ascribed to a single *Candida* sp. in 14 patients. In one patient, *C. albicans* and *C. glabrata* co-infection was identified. Using our PCR marker, threepatients (15%) were found to have mixed spp. infections, including the patient known to have *C. albicans/C. glabrata* co-infection. In one patient diagnosed originally with *C. glabrata* fungemia, *C. albicans* was also identified. In one patient diagnosed with *C. parapsilosis* fungemia, *C. fabianii* was also identified. In the latter two cases, analysis of colonies recovered from subculturing of blood culture bottles subsequently confirmed the presence of both spp. Comparative phenotypic studies of *C. parapsilosis* and *C. fabianii* isolates from the co-infected patient revealed that colony morphologies were indistinguishable on solid agar at 48 hours. Thereafter, *C. parapsilosis* formed smaller wrinkled colonies, comprised of a mixture of elongated and round cell morphologies, whereas *C. fabianii* demonstrated round small cells, and formed smooth, big colonies. In addition, *C. parapsilosis* showed increased agar invasion and echinocandin resistance. *C. fabianii* had increased growth rate, biofilm formation and resistance to neutrophil killing.

***Conclusion.*** Mixed *Candida* spp. may account for more cases of fungemia than currently recognized by clinical laboratories. In some cases, failure to detect mixed spp. infections can have important clinical implications, including failure to appreciate antifungal resistance. It is possible that complementary phenotypic or virulence characteristics between isolates of different spp. may potentiate pathogenesis. More efficient methods of screening for mixed *Candida* spp. infections are needed for clinical laboratories.

***Disclosures.*** **All authors:** No reported disclosures.

### 421. Babesiosis: Retrospective Review of 38 Cases from Upper Midwest

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**Session:** 57. Global Health and Travel Medicine
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***Background.*** Babesiosis is a tick-borne illness caused by protozoal infection of the genus *Babesia*. Clinical presentation varies widely from asymptomatic to rapidly fatal infection and diagnosis requires a high index of clinical suspicion. It is an emerging health risk and clinicians need to be aware of its different clinical manifestations.

***Methods.*** We retrospectively collected and analyzed data from 38 patients with babesiosis from 1990 to 2015.

***Results.*** Mean age of patients was 63 years. 68% of patients required hospitalization with 21% requiring intensive care unit (ICU) stay. Mean length of illness before diagnosis was 15.6 days and symptoms comprised of malaise (82%), subjective fever (71%), chills (55%), anorexia (29%), arthralgia (29%), and nausea (16%). Only 47% of the patients recalled tick bites. Mean hemoglobin in the outpatients was 12.4 g/dL compared with 9.8 g/dL in the hospitalized patients ($P < 0.01$). Among hospitalized patients, mean hemoglobin for ICU admissions was 7.5 g/dL vs. 10.9 g/dL ($P < 0.01$) for those without ICU stay. Mean parasitemia was 10.1% in those requiring ICU compared with 1.4% in those admitted to the medical floor ($P < 0.01$). 28.9% had Lyme disease, and 10.5% had anaplasma coinfection. Co-morbidities included diabetes mellitus ($n$ = 3), asplenia ($n$ = 5), and immunosuppression ($n$ = 3). Diagnosis was made with PCR and peripheral smear in 50% of patient whereas 50% were diagnosed with PCR alone. In 27% of patients with positive PCR, peripheral smear was negative. All patients with asplenia required hospitalization with 3/5 requiring ICU with initial parasitemia ranging from 2.5 to 28% and duration of parasitemia ranging from 10 to 142 days. Initial treatment comprised of clindamycin plus quinine in 31% of patients whereas combination of atovaquone and azithromycin was used in 69% of patients. Median duration of treatment was 10 days. Overall three patients underwent exchange transfusion with parasitemias ranging from 12.3 to 28.5%. None of the patients died during hospitalization.

***Conclusion.*** Less than half of the patients with babesiosis recall tick bites. There is usually a delay in diagnosis of up to 2 weeks due to nonspecific nature of symptoms. In more than one-fourth of patients with babesiosis peripheral smear may be falsely negative. Hemoglobin and percentage parasitemia seemed to correlate with severity of illness.

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### 422. Brucellosis Regimens Comparison in a Saudi Tertiary Academic Medical Center

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***Background.*** Brucellosis is a zoonotic infectious disease caused by *Brucella* spp. that affects multiple body systems and may lead to several complications. Saudi Arabia is one of the countries where brucellosis is endemic. The purpose of this study was to describe the epidemiological characteristics of brucellosis as well as assessing outcomes of different antibiotic regimens.

***Methods.*** A retrospective cohort study was conducted in a Saudi tertiary academic medical center. Eligible patients were adults with confirmed brucellosis (via culture, antibody test, or both) seen between January 2008 and March 2018 who received antibiotic therapy. Endpoints included clinical cure, all-cause mortality, and length of stay (LOS). Data were analyzed using ANOVA and chi-square. A $P$-value of < 0.05 was considered statistically significant.

***Results.*** Out of 580 patients screened, 79 met the criteria and were included in the study. Based on the most common regimens prescribed, patients were divided into three groups, doxycycline–rifampin–aminoglycoside (DRA) with 39 patients, doxycycline–rifampin (DR) with 28 patients, and other regimens with 12 patients. All groups did not differ in their baseline characteristics except for the location (mostly outpatients or inpatients and very few in the intensive care unit), duration of therapy, and the presence of co-infection (most patients did not have co-infections). The most common risk factor was consumption of raw dairy products and most patients had