Hyperspectral Fluorescence Microscopy Detects Autofluorescent Spectral Components That Can Be Exploited as a Diagnostic Method for Pathogen Species Differentiation

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Technology description

Hyperspectral confocal fluorescence microscopy (HCFM) and multivariate spectral analysis methods to quickly and accurately diagnoseCandidaspecies
This technique accurately identifies and characterizes the unique autofluorescence spectra from differentCandidaspecies grown in conditions that closely mimic physiological conditions with up to 84% accuracy. This work represents the first step toward developing a label-free method for rapid, culture-free identification of fungal species.

Background

Fungi in theCandidagenus are the most common fungal pathogens; they not only cause high morbidity and mortality, but can also cost billions of dollars in healthcare. In order to alleviate this burden, early and accurate identification ofCandidaspecies is necessary. However, standard identification procedures can take days and have a large false negative error. Studies have shown that late diagnosis and incorrect diagnosis ofCandidaspecies leads to a significant increase in mortality. In order to reduce mortality associated with fungal infections, early and accurate identification are essential. There are currently multiple clinical diagnostic methods used to support candidiasis diagnoses. Regardless of the detection method (e.g., mass spectrometry, PCR), a microbiological culture step is usually required prior to pathogen identification. This culture step can take between 2-5 days from receipt of a clinical sample (e.g., blood, catheter tip, sputum, urine) to microbiological identification. This long time-to-identification can lead to delays in initiation of optimal antimicrobial chemotherapy. Previous studies have shown relatively poor sensitivity of clinical diagnostics for candidiasis, with a 30-50% false negative rate for blood cultures in patients with autopsy-confirmed cases of candidiasis. This demonstrates the limitations for both time and reliability of current diagnosis for common existing diagnostic approaches for candidiasis. Accordingly, there is a great need for improved identification, differentiation and diagnostic tools.
Cellular autofluorescence has demonstrated potential as a clinical diagnostic method because it is noninvasive, label-free, and has the ability to supply morphological and biochemical information.

Autofluorescence emission can be used to detect microbial pathogens, such asM. tuberculosisand some pathogenic fungi, and also cancer cells. Utilizing autofluorescence is possible due to the differences in both structure and biochemistry of the pathogen and/or the biochemical changes in cells and tissue resulting from disease.

Technology Description

Researchers at the University of New Mexico and Sandia National Laboratories have developed hyperspectral confocal fluorescence microscopy (HCFM) and multivariate spectral analysis methods to quickly and accurately diagnoseCandidaspecies. This technique accurately identifies and characterizes the unique autofluorescence spectra from differentCandidaspecies grown in conditions that closely mimic physiological conditions with up to 84% accuracy. This work represents the first step toward developing a label-free method for rapid, culture-free identification of fungal species.

Publications

Hyperspectral fluorescence microscopy detects autofluorescent factors that can be exploited as a diagnostic method for Candida species differentiation

Application area

Ability to accurately predict theCandidaspecies, demonstrating the robustness of the procedure as a quick and accurate identification method
Label-free and culture-free identification of fungal species
Reduces morbidity and mortality in conjunction with traditional methods of fungal identification

Institution

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