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Automatic detection of pneumocystis jiroveci in microscopic images: adaeq learning-based approach
Erick Reyes Vera1,2, Juan Botero-Velencia3, William Glarido-Escobar2, Karen Arango2, Indira Berrios3, Tenny Naranjo Preciado1,2,3
1Department of Electronics and Telecommunications, Instituto Tecnológico Metropolitano, Medellin, Colombia
2Medical and Experimental Myology Group, Corporacion para Investigaciones Biologicas, Medellin, Colombia
3Department of Mechatronics and Electromechanics, Instituto Tecnológico Metropolitano, Medellin, Colombia

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Objective: Pneumocystis jiroveci is one of the diseases that most affect immunocompromised patients today, and under certain circumstances, it can be fatal. One of the most widely used techniques in diagnostic laboratories for the detection of its etiological agent is optical microscopy. However, some of the disadvantages of this technique are its low sensitivity, low accuracy, and high dependence on an expert to make the diagnosis. Thus, this work aims to develop a computational tool based on a deep learning approach to automatically detect the presence of P. jiroveci in images from optical microscopes, and to increase the accuracy of this conventional technique.
Methods: The study involved 29 randomized patients, from whom respiratory samples (bronchial lavage) and bronchoscopically-obtained lavage were collected. Methanamine silver staining was then used to prepare the samples. Subsequently, the slides of the analyzed patients were observed using the Leica DMI5000 microscope using a Leica HC50 HD camera, and the optical images were taken in at least four random positions on the specimen holder. Thus, an image dataset of 29 different patients was created to detect whether a patient is positive or negative for P. jiroveci. Finally, a deep learning approach based on convolutional neural networks (CNN) was proposed and evaluated to improve the accuracy of the microscopy technique. The proposed CNN model incorporates global and local features for pixel-wise segmentation.
Results: First, the dataset was processed and segmented using the connected-components methodology. Likewise, the segmented images were labeled with the help of an expert to train the algorithm. To validate the response of the proposed deep learning approach the obtained results were compared with the obtained conventional image classification techniques like co-occurrence matrix and K-NN. The obtained results reveal that the proposed methodology allows to increase the accuracy in the P. jiroveci images to 99%, while the co-occurrence matrix and K-NN alone achieve accuracies of 89% and 85%, respectively.
Conclusion: It is possible to demonstrate that techniques based on digital image processing are a useful tool to support the processes of analysis and diagnosis of samples in medical patients with P. jiroveci. In conclusion, the obtained results demonstrate that methods based on deep learning allow us to develop more accurate and accurate analysis methodologies for the analysis of patient samples with P. jiroveci. Our model can be improved by adding new layers, but this would introduce extra hyperparameters that should be adjusted. We intend to extend our model architecture in other areas of medical imaging with the usage of deep learning and computer vision techniques.

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The relationship between virulence of Candida albicans and environmental oxygen concentration
Masahiro Abe1, Sota Sedamoto1, Takayuki Shinohara2, Atsuki Nagemori3, Minoru Nogi4,5, Yoshitugu Miyasw1
1Department of Fungal Infections, National Institute of Infectious Diseases, Shirakita-ku, Japan
2Antimicrobial Resistance Research Center, National Institute of Infectious Diseases, Shiroki-ku, Japan

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Objective: Candida albicans strains are known to colonize human sites and mucosa, and cause candidiasis under various immunomorphologic conditions. Among these Candida species, C. albicans is reported to be the most frequently isolated species, and can colonize on skin, vagina, gastrointestinal tract, and medical devices. Environmental factors including oxygen concentration is thought to affect the capability of colonization and virulence of Candida species; however, most previous research was performed under aerobic conditions, and few research focused on hypoxic conditions imaging inside the human body. Since the study’s approaches, we performed our experiments by culturing C. albicans under various oxygen conditions to evaluate the effect of environmental oxygen concentration on virulence. Through our study, we aimed to clarify the actual behavior of C. albicans in the human body.
Methods: In this study, fully CFTR-/- mice, 7-8 weeks old, were used and injected via lateral tail vein to cause C. albicans dissemination. Mice were divided into 4 groups according to the pre-culture conditions: aerobic, microaerobic (5% oxygen concentration), microaerobic (5% oxygen concentration), and anaerobic. Under each oxygen condition, C. albicans was grown at $37^\circ\text{C}$ for 2 days on brain heart infusion (BHI) agar and then inoculated in YPD broth for 24-28 h. After inoculation, C. albicans was collected, resuspended in sterile PBS, and injected into each mouse at 5×105 colony-forming units. In this study, only reference strain (NC0114) and one clinically isolated strain (from bloodstream infection) were used. These infected mice were euthanized 2 or 4 days after injection, and organ (kidney and brain) fungal burdens were evaluated.

Results: The kidney’s fungal burdens were significantly higher in the microaerobic groups than those in the aerobic or anaerobic groups 2 and 4 days after injection. There was no significant difference between 5% oxygen concentration pre-cultured and 5% oxygen concentration pre-cultured group. On gross examination, disseminated lesion formations were visible in the kidneys of the microaerobic groups. Similarly, the fungal burdens of brain were significantly higher in the microaerobic pre-cultured groups than in the aerobically or anaerobically pre-cultured groups. This tendency was similar for both the reference and isolately isolated strains.

Conclusion: Our results indicated that C. albicans could become more virulent under hypoxia, especially under microaerobic conditions. We assumed that some virulence factors of C. albicans were elevated under microaerobic conditions. These results suggest that the environmental oxygen concentration may play an important role in determining the virulence of C. albicans. In the future, we will continue to evaluate factors related to this change in virulence and pathological analysis of infected organs.

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Pulmonary fungal infection in Sudan, a retrospective study from the Myology Reference Laboratory
Mawasho Ismail1,2, Aida Gabo1,2, Shanqin Zhou1, Ehsenkh Mahsoob1, Sarah Ahmed1,2
1Myology Reference Laboratory, Khartoum, Sudan, Khartoum, Sudan
2National Laboratory for Public Health, Sudan

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Objective: Pulmonary fungal infections are life-threatening diseases, if not diagnosed and properly treated can lead to serious complications. In chronic cases, the condition might mimic tuberculosis and may be misdiagnosed. The aim of this retrospective study is to determine the frequency of fungi among the respiratory samples received at the myology reference laboratory over 5 years period and to provide a view of the burden of pulmonary fungal disease in the country.
Methods: A total of 753 sputum samples received at the Myology Reference Laboratory, Khartoum, Sudan, between 2015-2019 were analyzed. These samples were collected from different health care centers in Khartoum state. For every sample, direct microscopy using 20% KOH and methylene blue stain was performed. In addition, cultures were made by inoculating each sample in three tubes of brain heart agar (BHA) containing chloramphenicol. Tubes were incubated at 37°C for 2 and up to 7 days. Isolated fungi were identified phenotypically using the Atlas of Clinical Fungi guidelines.
Results: Out of the 753 samples, 231 (31%) were positive for fungi, both in the direct microscopy and culture. Cultures were identified as Aspergillus species 99 (16%), while 194 (26%) were found to represent Candida species.
Conclusion: Our study showed a high number of fungi is associated with pulmonary conditions in Sudan. Risk factors might include post tuberculous, Arusha, HIV, and COPD.