Fungal and Bacterial Infections Discrimination in ICU Patients based on serum molecular fingerprint

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ABSTRACT

The rapid discrimination between fungal and bacterial infections in intensive care unit (ICU) patients is crucial for an efficient antimicrobial therapy. This work aims to develop a predictive model capable of discriminating fungal and bacterial infections among these patients based on a rapid serum analysis. Serum from 46 patients at ICU, with COVID-19, were analyzed by Fourier-Transform infrared (FTIR) spectroscopy: 17 did not present any other infection; 12 presented bacterial infections (including Enterobacter aerogenes (2), Escherichia coli (4), Enterococcus faecalis (1), Haemophilus influenzae (1) and Serratia marcescens (1), Klebsiella pneumoniae (3)), isolated from blood, tracheobronchial aspiration, bronchoalveolar lavage and urine; 17 with fungal infections (including Candida albicans (14), C. tropicalis (1), C. parapsilosis (1) and C. glabrata (1), isolated from bronchoalveolar lavage, urine and urethral exudate. The impact of a Fast Correlation Based Filter (FCBF) of normalized second derivatized spectra (between 406-1800 and 2800-3992 cm^{-1}) was evaluated on a t-distributed Stochastic Neighbor Embedding (t-SNE), and a Naïve-Bayes model. The predictive models were based on 10 random iterations, with 80% of samples

used for training and the remaining 20% for validation. The impact of FCBF was evaluated on t-SNE to select the spectral bands with high significance in detecting the infection and in discriminating the bacterial from the fungus infection. Optimized Naïve-Bayes models enabled to detect the infection with a sensitivity of 83% and a specificity of 81%, and the discrimination of the bacterial and fungal infection with a sensitivity and specificity of 86% and 96%, respectively. Serum analysis, based on FTIR spectroscopy associated to machine learning algorithms presents a high potential to detect in a rapid and economic mode either the infection either the discrimination between bacterial or fungal infection.