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EXTENDED ABSTRACT

Study of associations between COVID-19 and bacterial infections: a retrospective study

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Introduction:

The COVID-19 pandemic disease, caused by the Severe Acute Respiratory Syndrome Coronavirus 2 (Sars-CoV-2), has affected millions of people worldwide. Clinical practice highlights that the number of patients with COVID-19 diagnosed with bacterial infections during periods of hospitalization is increasing. Rapid characterization of co-infection is essential in the treatment of most patients with COVID-19, as it can result in failure of antimicrobial therapy. Some studies report the prevalence of variable coinfection among patients with COVID-19, however, it can be up to 50% in patients who did not survive. [1, 2]

The present study aims:

- To assess the occurrence of associations between COVID-19 and bacterial infections in patients hospitalized at Centro Hospitalar Baixo Vouga – Aveiro between April 1, 2020 and December 31, 2021.

- Contribute to the definition of pharmacological therapy strategies in patients with mixed, bacterial and Sars-CoV-2 infections.

Methods:

A total of 9194 Sars-CoV-2 test results (Abbott molecular) and 3374 clinical isolates (MALDI Biotyper® - Bruker), from various clinical sources, obtained between April 1, 2020 and October 31, 2021 from Centro Hospitalar Baixo Vouga – Aveiro, Portugal, were studied. Bacterial infections on hospitalized patients which had a positive COVID-19 test (n = 183) in a period of in a period of -30 and +30 days, were selected. The most prevalent bacteria in patients COVID-19 positive were determined and associations between occurrence of COVID-19 infection and occurrence of each bacterial infection, analysed. The association strength was evaluated through Odds Ratio (OR) and it 95% confidence interval. The chi-square testing with P values <0.05 were considered as significant association effect. All statistical analyses were performed using R software, using epiR package.

Results:

We studied 183 hospitalized patients that had positive COVID-19 test and bacterial infections. The percentage of infection was 9,8%. There are several isolates per patient (average 1,7 per patient). The most prevalent bacteria in patients COVID-19 positive are *Escherichia coli* (19,03%), *Klebsiella pneumoniae* (14,84%), *Staphylococcus aureus* (10,65%), *Pseudomonas aeruginosa* (7,42%), *Proteus mirabilis* (7,74%), *Staphylococcus epidermidis* (4,52%), *Candida albicans* (5,16%) and *Enterococcus faecalis* (4,84%). In patients COVID-19 negative (n = 1668) the most prevalent are *Escherichia coli* (21,57%), *Klebsiella pneumoniae* (13,84%), *Enterococcus faecalis* (7,25%), *Staphylococcus aureus* (6,63%), *Staphylococcus epidermidis* (6,49%), *Pseudomonas aeruginosa* (6,20%), *Candida albicans* (5,22%), *Proteus mirabilis* (3,82%). There is a significant association of occurrence between COVID-19 infection and five bacteria (Table 1).

Discussion:

For five bacteria the OR association strength can be considered moderated. There are differences in bacterial infections between positive and negative COVID-19 patients, mainly in *Staphylococcus aureus*. These results strength the importance to further studies on this association including the evaluation of co-morbidities, microbiological distribution, probable increase of nosocomial infection and patient mortality during hospital admission. Agents like *Staphylococcus epidermidis* could be colonisations and is need

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careful to understand this data. This analysis may contribute to help in the definition of empirical therapies in patients with mixed COVID-19 and bacterial infections.

Table 1 - Associations between COVID-19 infection and each bacterial infection.

	COVID + n = 405	**COVID -** n = 8790	**OR**	**LBCI95%**	**UBCI95%**	**p-value***
Escherichia coli	59	661	2.10	1.57	2.79	<0.001
Klebsiella pneumoniae	46	424	2.53	1.83	3.49	<0.001
Staphylococcus aureus	33	203	3.75	2.56	5.50	<0.001
Pseudomonas aeruginosa	23	190	2.73	1.75	4.25	<0.001
Proteus mirabilis	24	117	4.67	2.97	7.33	<0.001
Staphylococcus epidermidis	15	226	1.55	0.89	2.68	0.952
Candida albicans	16	160	2.22	1.31	3.75	0.016
Enterococcus.faecalis	15	226	1.55	0.89	2.68	1.000

* adjusted to simultaneous testing (Bonferroni correction)

Ethics committee and informed consent:

The current research was approved by CHBV ethics committee.

References:

1. Adalbert, J.R., Varshney, K., Tobin, R. et al. Clinical outcomes in patients co-infected with COVID-19 and *Staphylococcus aureus*: a scoping review. BMC Infect Dis 21, 985 (2021). https://doi.org/10.1186/s12879-021-06616-4
2. Mirzaei R, Goodarzi P, Asadi M, et al. Bacterial co-infections with SARS-CoV-2. IUBMB Life. 2020;72(10):2097-2111. https://doi.org/10.1002/iub.2356