



(RESEARCH ARTICLE)



Pulmonary bacterial superinfections in covid-19 patients hospitalized for severe acute respiratory syndrome (SARS) in the intensive care unit

Lamiae Arsalane ^{1,3}, Maria Jaimi ^{1,3}, Kenza El Bazi ^{1,3,*}, Mouhcine Miloudi ^{1,3}, Youssef El Kamouni ^{1,3}, Said Zouhair ^{1,3} and Abderrahman Boukhira ^{2,3}

¹ Department of Bacteriology and virology, Avicenne Military Hospital, Marrakech, Morocco.

² Department of Biochemistry, Avicenne Military Hospital, Marrakech, Morocco.

³ Faculty of medicine and pharmacy of Marrakesh – Cadi Ayyad University, Marrakech, Morocco.

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Abstract

The objective of this study is to describe the bacteriological and biochemical profile of bacterial pulmonary superinfections in COVID 19 patients hospitalized in the ICU (Intensive Care Unit) of the Avicenna military hospital of Marrakech. A descriptive retrospective study was conducted, including all covid 19 patients admitted to the intensive care unit for respiratory distress syndrome. 338 samples were tested of which 118 came back positive. Of the 118 samples, 82 (69.5%) were BAL and 36 (30.5%) sputum. None of the PDPs, bronchial aspirates, and pleural punctures came back positive. The most frequently found germs are: *Acinetobacter baumannii* at 28.8%, followed by *K. pneumoniae* at 18.6%, *Pseudomonas aeruginosa*, and *Staphylococcus aureus* (14.4% each). Multi-drug resistant bacteria were found in 62 samples (52%). The most frequent MDR-bacteria were: *Acinetobacter baumannii* resistant to imipenem (29/118) 24.8%. The CRP (C-reactive protein) achieved in all our patients was high in 100% of cases. Values ranged from 30 to 564 mg/L with an average of 195.13 mg/L.

Meanwhile, Procalcitonin performed in 55 of our patients (72% of cases) was positive in 45 patients (82% of cases). Values ranged from 0.1 to 60 ug/L with an average of 11.19 ug/L.

Keywords: Covid-19; Intensive Care Unit; Antibiotics Resistance; CRP; Procalcitonin

1. Introduction

In 2020, the world experienced one of the most dreadful pandemics due to the SARS-Cov 2 virus, with more than 76 million cases and 1.6 million deaths until December 2020. In February 2020. The WHO named the disease due to a new virus, COVID 1 [1]. Although the majority of patients only developed mild to moderate symptoms, the latter also caused a large number of intensive care hospitalizations [2]. Bacteria-related superinfections during ICU (Intensive Care Unit) hospitalization have been widely reported in the literature, but data remain limited regarding COVID 19 [3]. The incidence of the different studies varies between 3.6 and 43% [3,4], however rare are the studies focusing only on patients admitted to the ICU. Procalcitonin (PCT) and CRP (C-reactive protein) are useful in lower respiratory infections and may therefore aid in the differentiation between isolated viral infection and bacterial superinfection [5]. In this study, we describe the bacteriological and biochemical profile of bacterial pulmonary superinfections in COVID 19 patients hospitalized in the ICU of the Avicenna military hospital in Marrakech.

* Corresponding author: Kenza El Bazi
Bacteriology and virology department, Avicenne Military Hospital, Marrakech, Morocco.

2. Methods

2.1. Type of study

A descriptive retrospective study including all covid 19 patients admitted to the intensive care unit for respiratory distress syndrome.

2.2. Study population

Included in the study were all patients with a positive SARS-Cov 2 PCR (Polymerase chain reaction) in nasal or lung samples and who were hospitalized in the intensive care unit.

2.3. Data collection

The data collection was based on a digitized operating sheet at the microbiology and biochemistry laboratory department of the Avicenne Marrakech military hospital.

We included only patients whose infection was confirmed by a positive culture associated with clinical, biological, and radiological signs of infection.

Objective of the study

Study the bacteriological and biochemical profile of pulmonary bacterial superinfections in COVID 19 patients.

3. Results

3.1. Characteristics of our samples

338 samples were tested of which 118 came back positive. Of the 118 samples, 82 (69.5%) were BAL (Bronchoalveolar lavage) and 36 (30.5%) sputum. None of the PDPs (Distal protected pulmonary sample) , bronchial aspirates, and pleural punctures came back positive. These 118 samples were obtained from 76 patients (1 sample from 48 patients, 2 samples from 17 patients, 3 samples from 9 patients, 4 samples from 1 patient, and finally 5 samples from 1 patient). Multiple specimens from the same patient were ordered by the clinician on a delayed basis.

80% of the cases in our study are male and the average age in our study is 61 years old.

3.2. Bacteriological profile of our samples:

The most frequently found germs are: *Acinetobacter baumannii* at 28.8%, followed by *K. pneumoniae* at 18.6%, *Pseudomonas aeruginosa*, and *Staphylococcus aureus* (14,4% each).

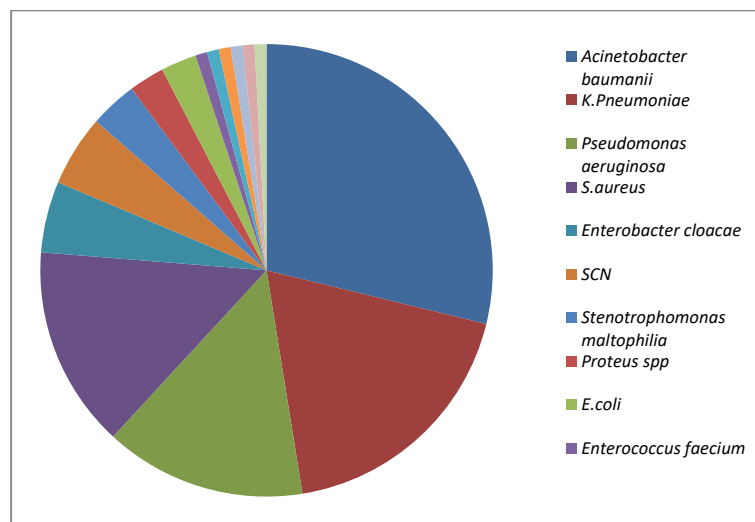


Figure 1 Distribution of the bacteria implicated in lung infections secondary to Covid-19

Multi-drug resistant bacteria were found in 62 samples (52%). The most frequent MDR-bacteria were: *Acinetobacter baumannii* resistant to imipenem (29/118) 24.8%, PARC (2/118) 2%, C3G-resistant *Enterobacteriaceae* (24/118) 20% and MRSA (7/118) 6%. Carbapenemase production was found in (56/118) 47% of cases.

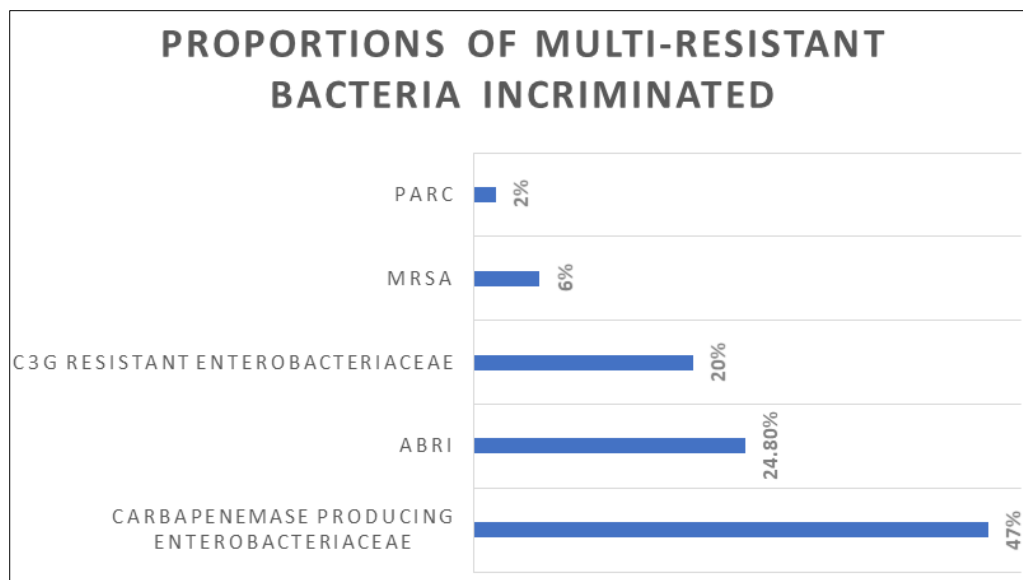


Figure 2 Proportions of multi-drug resistant bacteria incriminated

3.3. Biochemical profile of our samples

The CRP achieved in all our patients was high in 100% of cases. Values ranged from 30 to 564 mg/L with an average of 195.13 mg/L

Meanwhile, Procalcitonin performed in 55 of our patients (72% of cases) was positive in 45 patients (82% of cases). Values ranged from 0.1 to 60 ug/L with an average of 11.19 ug/L.

4. Discussion

Were included in this study a total of 118 pulmonary superinfections in 76 patients, with a clear predominance of gram-negative bacteria. *Acinetobacter baumannii* represented 28.8% of cases, *K. pneumoniae* represented 18.6% and *Pseudomonas aeruginosa* represented 14.4%. Gram-positive bacteria were following, including *Staphylococcus aureus* with 14.4% of cases. In a review that studied several papers dealing with pulmonary bacterial superinfection in COVID 19 patients, the type and frequency of bacterial superinfection were reported to be as follows 21.1% (75/355) *Pseudomonas aeruginosa*, 17.2% (61/355) *Klebsiella* species, 13.5% (48/355) *Staphylococcus aureus*, 10.4% (37/355), *Escherichia coli*, and 3.1% (11/355) *Stenotrophomonas maltophilia* [6]. *Acinetobacter baumannii* and *Pseudomonas aeruginosa* [4,7], while others have found that the most predominant germs are: *Mycoplasma pneumoniae*, *Pseudomonas aeruginosa*, *Haemophilus influenzae* and *Klebsiella pneumoniae* [3].

We also observed in our study a high rate of MDR bacteria, a study carried out in an intensive care unit in Spain [8] reports similar rates with MRSA as predominant MDR. These results can be explained by the pressure exerted on the intensive care units as well as on the whole hospital during the COVID 19 pandemic. This involved a temporary relocation of the health personnel as well as a redirection of the control measures aimed at stopping the spread of the virus. Thus generating less attention towards other ordinary measures for the prevention of nosocomial infections.

Serum procalcitonin is useful for the identification of bacterial superinfections in COVID 19 patients. In general, in COVID 19 or other viral infections, procalcitonin levels remain within the norms. The absence of PCT elevation in viral infections may be due to the secretion of INF gamma (Interferon gamma) by macrophages which inhibit the secretion of TNF alpha in the immune response [9]. The association of PCT and pulmonary superinfection in hospitalized COVID 19 patients has been demonstrated in a few studies (10), Van Berkel et al objectified that a PCT level < 0.25 ug/L had a negative predictive value of 81%, while a level > 1ug/L had a positive predictive value of 93%. The author then concludes that antibiotic therapy can be stopped safely in COVID 19 patients in the ICU with a low PCT [5]. CRP is an unreliable

marker, as it remains high in COVID 19 patients even in the absence of bacterial superinfection [5]. A series of CRP assays with rising or falling levels can be offered to the clinician to exclude or confirm superinfection [5]. Regarding the results of our study, only 72% of our patients benefited from a procalcitonin assay with a positivity percentage of 82%. This can be explained by the unavailability of the dosage of this marker at the precise moment of superinfection and therefore the delay of the latter, thus explaining the negative results found in some of our patients. As for the CRP, it was positive in 100% of our patients, thus joining the data found in the literature.

5. Conclusion

The results observed in this study show a high rate of MDR bacteria. Values of CRP found for the sera tested were high in 100% of cases, and procalcitonin was positive in 82% of cases. Our results show a great concordance between the bacteriological profile and biochemical profile of the samples tested. The results found concerning the procalcitonin levels demonstrate the reliability of the test for early detection of secondary bacterial superinfections.

Compliance with ethical standards

Acknowledgments

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Disclosure of conflict of interest

The authors declare no conflict of interest.

Statement of ethical approval

All the data has been collected anonymously following patient confidentiality.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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