ISSN: 2577 - 8005

Research Article

Medical & Clinical Research

Bacterial Infections Associated with COVID-19 Infection in Thi-Qar Province, Iraq

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Submitted:22 Sep 2023;**Accepted**: 29 Sep 2023;**Published**: 10 Oct 2023

Citation: *Talib F. Hassen (2023) Bacterial Infections Associated with COVID-19 Infection in Thi-Qar Province, Iraq. Medical & Clinical Research, 8(10), 01-06.*

Abstract

Background: *Bacteriological study of clinical samples obtain from patients hospitalized with COVID-19 acquired bacterial infections. The etiology and antimicrobial resistance of bacteria were reported and used for the latest information on the relationship between bacterial infections and COVID-19.*

Methods: *Clinical samples from COVID-19 patients were collected and analyzed for the presence of bacterial infections. Bacterial species were identified using established microbiological and molecular techniques. Antibiotic susceptibility testing was performed on isolated bacteria.*

Results: *Bacterial infections associated with COVID-19 were studied. 384(29.4%) of patients showing evidence of bacterial infections. A total of 231 patients, accounting for 60.2% of the sample, were identified as male, while 153 patients, representing 39.8% of the sample, were identified as female. A total of 226 isolates (58.8%) were identified as bacterial species, with 158(41.2%) classified as Gram-negative bacteria and the remaining 41.2% classified as Gram-positive bacteria. The proportion of bacterial isolates in the blood was higher than other sites. Antibiotic susceptibility testing revealed varying degrees of resistance.*

Keywords: Bacterial Infections, Covid-19, Etiology, Antimicrobial Sensitivity

Introduction

The global outbreak of coronavirus disease 2019 (COVID-19), caused by severe acute respiratory syndrome coronavirus [1-5]. While it is true that certain individuals are sent to hospitals as a result of severe respiratory illness stemming from COVID-19, more critical instances necessitate admission to Intensive Care Units (ICUs) where mechanical ventilator assistance is provided [6]. While it is true that the majority of COVID-19-related deaths are observed in older individuals with pre-existing health conditions, it is important to note that healthcare-associated pneumonia, specifically in patients who require intubation, remains a notable contributing factor in intensive care units [7]. It is worth noting that individuals across all age demographics who do not possess an underlying medical condition may also face the possibility of developing a secondary bacterial infection [8]. Infection and its associated pathogenesis, emerging evidence suggests a potential interplay between viral and bacterial infections, thereby complicating the clinical course and management of affected individuals [9,10]. While the primary focus has been on understanding the virological and immunological aspects of COVID-19, there is growing recognition of the potential for secondary bacterial infections to contribute to disease severity and outcomes [11]. Bacterial co-infections, often arising during the course of viral respiratory infections, can significantly influence clinical manifestations, treatment st.ategies, and patient prognoses. Consequently, a comprehensive understanding of the incidence [12,13], bacterial species involved, antibiotic resistance patterns, and clinical implications of secondary bacterial infections in COVID-19 patients is of paramount importance [14,15].

This paper aims to address this critical knowledge gap by presenting a comprehensive analysis of bacterial infections associated with coronavirus infections. Investigate the incidence of bacterial infections among individuals diagnosed with COVID-19.Identify and characterize bacterial species implicated in bacterial infections among COVID-19 patients. Assess antibiotic susceptibility patterns of isolated bacterial strains and evaluate the emergence of antibiotic resistance.

Materials and Methods

Materials

Study population

1. During the period spanning from July 1, 2021 to December 31, 2021, a total of 1307 patients who tested positive for COVID-19 received medical diagnosis and treatment in the Intensive Care Unit (ICU) of Al-Hussien Teaching Hospital, located in the Thi. Qar governorate. The clinical samples under investigation include the following:

2. ***Clinical Samples:*** Clinical samples, such as respiratory secretions (sputum, nasal swabs, throat swabs) or blood, where collected from COVID-19 patients who are suspected of having bacterial infections.

3. ***Bacterial Isolates:*** Isolates of bacterial strains associated with bacterial infections are collected and cultured for further analysis.

4. ***Laboratory Reagents:*** Various reagents and media are used for bacterial culture, identification, and antibiotic susceptibility testing.

Methods

1. ***Microbiological Culture:*** Clinical samples are cultured on appropriate bacterial growth media to isolate and identify bacterial pathogens.

2. ***Bacterial Identification:*** Traditional methods such as biochemical tests, microscopic characteristics and culture characteristics are used to identify bacterial species.

3. ***Antibiotic Susceptibility Testing:*** The susceptibility of isolated bacteria to antibiotics is determined through methods like disk diffusion, broth micro dilution, or automated systems. The strains originating from a single patient were considered as unique entities and were not duplicated in the counting process. The reference strains employed for quality control were Escherichia coli ATCC 25922 and Staphylococcus aureus ATCC 25923.

4. ***Imaging Techniques:*** Techniques like chest X-rays or CT scans may be used to identify signs of bacterial pneumonia in COVID-19 patients.

5. ***Data Analysis:*** Statistical analyses are performed to assess the prevalence of bacterial infections, the distribution of bacterial species, and their antibiotic resistance patterns.

Results

General information A total of 1307 patients were diagnosed with COVID-19 and treated in ICU between July 2021 and December 2021. 847(64.8%) were male and 460(35.2) were female table Figure 1 recorded in the Thi.Qar governorate and hospitalized in Al-Hussien Teaching Hospital which was specified for COVID-19 patients only.

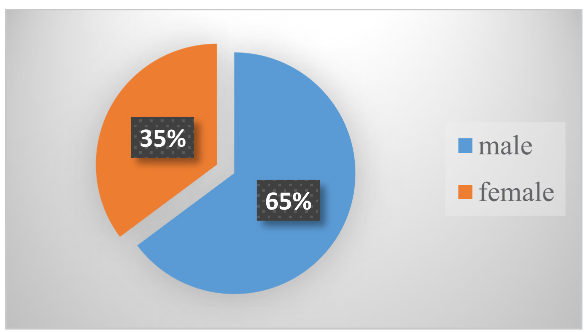

Figure 1: Sex distribution of Covid19 infections.

Figure 2 show age distribution in patients with COVID-19. Most of cases infections in age group more than fifty years old were over 81 year, (61----70) and (71----80) were (21.9%), (19.9%) and (18.8%) respectively .

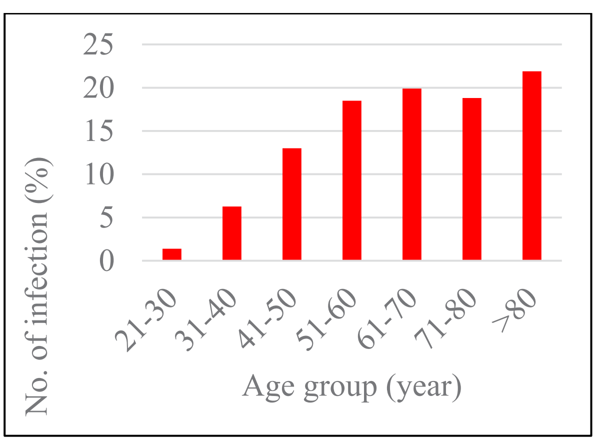

Figure 2: Age distribution of COVID -19 infections during study period.

384 a patients with bacterial infections (29.4%) were included in the study. 231(60,2%) of the patients were male and 153(39.8%) were female Table 1, length of pre-ICU stay for patients was 6-12 days,

Total infections	Male		Female	
384	No.	%	No.	%
	231	60.2	153	39.8

Table 1: Sex distribution of bacterial infections in patients with COVID-19.

Etiological distribution of bacterial isolates in patients hospitalized with COVID-19, 226 isolates (58.8%) were Gram-negative bacteria and 158(41.2%) were Gram-positive bacteria. The most common agents of isolates were *P. aeruginosa*, 75(19.5), *S. aureus,* 65(16.9%) *K. pneumoniae*, 62(16.1%) *Acinetobacter spp* 48(12.6%). The distribution of all isolated bacteria is shown in Table 2.

Bacteria	No.of Isolates	Percentage %
G-ve bacteria (No.=226)		
Pseudomonas aeruginosa	75	19.5
Klebsiella pneumoniae	62	16.1
Acinetobacter spp	48	12.6
Escherichia coli	22	5.7
Haemophilus influenzae	19	4.9
G+ve bacteria (No.=158)		
Staphylococcus aureus	65	16.9
Enterococcus faecalis	37	9.6
Staphylococcus epidermidis	32	8.3
Streptococcus pneumoniae	24	6.2
Total	384	100

Table 2: Etiological distribution of bacterial infections in patients with COVID-19.

The proportion of bacterial isolates in the blood, nasal swabs and throat swab were 154(40.1%), 110(28.6%) and 75(19.5%), respectively, Table 3.

Bacteria	nasal swabs	throat swabs	sputum	blood	Total
G-ve bacteria (No.=226)					
Pseudomonas aeruginosa	21	25	10	19	75
Klebsiella pneumoniae	18	15	19	10	62
Acinetobacter spp	16	8	7	17	48
Escherichia coli	6	4	1	11	22
Haemophilus influenzae	5	6	0	8	19
G+ve bacteria (No.=158)					
Staphylococcus aureus	15	3	0	47	65
Enterococcus faecalis	2	4	5	26	37
Staphylococcus epidermidis	24	0	0	8	32
Streptococcus pneumoniae	3	10	3	8	24
Total	110(28.6)	75(19.5)	45(11.7)	154(40.1)	384(100)

Table 3: Site of bacterial isolates distribution in patients with COVID-19.

The antibiotic resistance rate exhibited by bacteria obtained from patients diagnosed with COVID-19 was observed to be generally modest. The antibiotic susceptibility testing outcomes for the prevalent Gram-negative and Gram-positive bacteria are presented in Table 4 and Table 5, respectively.

Antibacterials	*P.aeruginosa (n=75)*	*K.pneumoniae (n=62)*	*Acinetobactr S.P (n=48)*	*E.coli. (n=22)*	*H.infleunzae (n=19)*
Amoxicillin/Clavulanate	67(89.3)	53(85.4)	39(81.2)	18(81.8)	16(84.2)
Ceftriaxone	62(82.6)	51(82.2)	42(87.5)	20(90.9)	17(89.4)
Ciprofloxacin	64(85.3)	57(91.9)	41(85.4)	19(86.3)	17(89.4)
Ampicillin	33(44)	34(54.8)	31(64.5)	13(59)	12(63.1)
Cefoxitin	59(78.6)	51(82.2)	37(77)	18(81.8)	13(68.4)
Amikacin	62(82.6)	54(87)	41(85.4)	17(77.2)	11(57.8)
Gentamicin	42(56)	38(61.2)	29(60.4)	13(59)	11(57.8)
Trimetoprim/Sulfamethoxazole	57(76)	51(82.2)	39(81.2)	15(68.1)	14(73.6)
Meropenem	51(68)	54(87)	37(77)	17(77.2)	14(73.6)
Cefepime	60(80)	53(85.4)	41(85.4)	18(81.8)	17(89.4)
Cefuroxime	59(78.6)	55(88.7)	38(85.4)	18(81.8)	17(89.4)
Imipenem	56(74.6)	59(95.1)	37(77)	14(63,6)	15(78.9)

Table 4: Sensitivity pattern of Gram-negative bacteria. N (%) of susceptible isolates.

Antibacterials	*S. aureus (n= 65)*	*E. faecalis (n= 37)*	*S. epidermidis (n= 32)*	*S.pneumoniae (n= 24)*
Penicillin	32(49.2)	22(59.4)	21(65.6)	11(45.8)
Ampicillin	33(50.7)	20(54)	21(65.6)	11(45.8)
Erythromycin	41(63)	29(78.3)	23(71.8)	20(83.3)
Clindamycin	46(70.7)	28(75.6)	22(68.7)	14(58.3)
Ciprofloxacin	52(80)	34(91.8)	27(84.3)	21(87.5)
Moxifloxacin	53(81.5)	31(83.7)	26(81.2)	20(83.3)
Gentamicin	33(50.7)	21(56.7)	19(59.3)	13(54.1)
Vancomycin	60(92.3)	33(91.8)	30(93.7)	21(87.5)
Daptomycin	54(83)	32(86.4)	29(90.6)	20(83.3)
Cefoxitin	49(75.3)	31(83.7)	28(87.5)	19(79.1)

Table 5: Sensitivity pattern of Gram-positive bacteria. N (%) of susceptible isolates

Ciprofloxacin, Ceftriaxone, Ampicillin, Amoxicillin/Clavulanate, and Cefepime were more effective antibacterial against most isolates of Gram negative bacteria,while less effect of antibacterial were Ampicillin and Gentamicin Table 4. Vancomycin, Daptomycin, Moxifloxacin, and ciprofloxacin were effective against most isolates of Gram positive bacteria ,while less effect of antibacterial were Pencillin, Ampicillin and Gentamicin Table 5. All isolates appear about 10% to 50% of resistance to antibacterial which used in this study.

Discussion

As of my last knowledge update in September 2021, there was ongoing research into bacterial infections associated with COVID-19, In a total of 1307 patients were diagnosed with COVID-19, 384 a patients with bacterial infections (29.4%) were included in the study. 231(60,2%) of the patients were male and 153 (39.8%) were female was isolated in cultures taken at the time of admission to the ICUs. Bacterial infections can occur secondary to viral infections like COVID-19 due to various factors, including a weakened immune response, similar findings found by [16-18]. the use of ventilators and other medical devices, and prolonged hospital stays this result go with [19,20]. Patients with severe COVID-19, especially those in intensive care units (ICUs), are at a higher risk of developing bacterial infections. This could be due to a compromised immune system or prolonged hospitalization, leading to exposure to hospital-acquired bacteria.This result go with [21]. In some cases, antibiotics are prescribed to COVID-19 patients to prevent or treat bacterial infections. However, the misuse of antibiotics can lead to antibiotic resistance, similar result found by [22]. Patients with severe COVID-19 may require mechanical ventilation, and this increases the risk of developing ventilator-associated bacterial infection. Healthcare workers dealing with COVID-19 patients are at risk of exposure to both the virus and opportunistic bacterial pathogens. Proper use of personal protective equipment and infection control measures are essential to prevent both viral and bacterial infections. this result confirmed by [23]. Most of cases infections in age group more than fifty years old while others mentioned sixty-five years old [24,25].

Recent studies related to COVID-19 reported that the male gender was a risk factor for disease severity status, a risk factor related to death [26-28]. In the study examining the etiological distribution of bacterial isolates in patients hospitalized with COVID-19, it was found that out of the total 226 isolates, 58.8% were identified as Gram-negative bacteria, while the remaining 41.2% were identified as Gram-positive bacteria similar result confirmed by [29-31]. The most common agents of isolates were P. aeruginosa 75(19.5), *S. aureus* 65(16.9%), *K. pneumoniae* 62(16.1%), *Acinetobacter spp*

48(12.6%). This result go with [32-34]. The sites of bacterial isolates were blood , nasal swabs , throat swab and sputum , and the high percentage was nasal swabs similar result found by [35]. The antibiotic resistance rate of bacteria obtained from individuals diagnosed with COVID-19 was observed to be generally modest. while Mumcuoğlu, İ.,et al, (2022) in Turkey found that the high resistance among bacterial strain which isolated from patients with COVID-19 [36]. Several studies have reported a significant level of resistance among the isolates to several antibacterial agents [37-40].

Conclusion

Bacterial infections may arise in individuals who have been admitted to the hospital with COVID-19, either concurrently with or subsequent to their ICU stay for COVID-19. Bacterial infections can occur secondary to viral infections like COVID-19 due to various factors, including a weakened immune response, Research was being conducted to better understand the interplay between the viral infection, the immune response, and susceptibility to bacterial infections. The use of ventilators and other medical devices, and this increases the risk of bacterial infection-associated with COVID-19 and prolonged hospital stays. the misuse of antibiotics can lead to antibiotic resistance, which is a global health concern. Research were studying appropriateantibiotic use in COVID-19 cases to balance the need for bacterial infection prevention while minimizing the risk of antibiotic resistance.

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