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ORIGINAL ARTICLE

CLINICAL CHARACTERISTICS AND PREDICTORS OF MORTALITY AMONG PATIENTS WITH SEVERE COVID-19 ADMITTED TO AN INTENSIVE CARE UNIT IN LAGOS, NIGERIA

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ABSTRACT

Introduction

Coronavirus disease 2019 (COVID-19) remains an important cause of severe illness and mortality worldwide. Patients requiring intensive care frequently have underlying comorbidities and multiple organ dysfunction, which adversely influence clinical outcomes. This study evaluated the clinical characteristics, laboratory findings, and predictors of mortality among patients with severe COVID-19 admitted to an intensive care unit (ICU) in Lagos, Nigeria.

Methods

This retrospective descriptive study reviewed the medical records of adult patients with confirmed COVID-19 admitted into the ICU of First Cardiology Consultants Hospital, Lagos. Demographic characteristics, clinical features, comorbidities, laboratory parameters, and treatment outcomes were extracted and analysed using SPSS version 25. Factors associated with mortality were assessed using appropriate statistical tests and multivariable logistic regression. Statistical significance was set at p <0.05.

Results

Thirty-five patients were included, comprising 28 (80.0%) males and 7 (20.0%) females, with a mean age of 58.4 ± 13.5 years. Hypertension (60.0%) and diabetes mellitus (48.6%) were the commonest comorbidities. Overall mortality was 14.3%. Non-survivors were significantly more likely to have tachycardia, hypertension, hypoxaemia, renal dysfunction, hepatic dysfunction, elevated C-reactive protein, elevated D-dimer, and impaired renal function. Multivariable analysis identified tachycardia as an independent predictor of mortality (p=0.031).

Conclusion

Severe COVID-19 requiring intensive care was associated with a high burden of comorbidities and organ dysfunction. Tachycardia emerged as an independent predictor of mortality, while hypoxaemia, hypertension, renal dysfunction, and hepatic dysfunction were significantly associated with poor outcomes. Early identification and aggressive management of these high-risk features may improve survival among critically ill patients with COVID-19.

Keywords: COVID-19; Intensive care unit; Mortality; Predictors; Tachycardia; Hypertension; Nigeria

INTRODUCTION

The coronavirus disease 2019 (COVID-19) pandemic, caused by the novel **Severe Acute**

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Respiratory Syndrome Coronavirus 2 (SARS-CoV-2), has had an unprecedented impact on global health systems since its emergence in Wuhan, China, in late 2019.[1,2] Although the majority of infected individuals experience asymptomatic or mild illness, a significant proportion develop severe disease requiring hospitalization, with some progressing to respiratory failure, multi-organ dysfunction, intensive care unit (ICU) admission, and death.[3,4]

Reported mortality among critically ill patients with COVID-19 varies considerably across regions, reflecting differences in patient characteristics, healthcare resources, disease severity, and management strategies.[5] While advances in supportive care and therapeutic interventions have improved survival, mortality among patients requiring intensive care remains substantial, particularly among older adults and those with underlying comorbidities.[6,7]

Several clinical and laboratory factors have been associated with poor outcomes in COVID-19. Advanced age, hypertension, diabetes mellitus, cardiovascular disease, chronic kidney disease, obesity, hypoxaemia, and elevated inflammatory biomarkers have consistently been identified as predictors of disease severity and mortality.[1,5,8–10] Early recognition of these risk factors is essential for prompt risk stratification, appropriate allocation of critical care resources, and timely institution of evidence-based interventions.

Nigeria, like many low- and middle-income countries, faced considerable challenges during the COVID-19 pandemic, including limited intensive care capacity and resource constraints. Nevertheless, local studies have demonstrated that increasing age, underlying comorbidities, and severe clinical presentation significantly influence patient outcomes.[11,15,16] Understanding factors associated with mortality within the Nigerian setting is important for improving clinical decision-making and optimizing the management of critically ill patients.

Although several international studies have identified predictors of mortality among patients with COVID-19, relatively few reports have focused specifically on critically ill Nigerian patients managed in intensive care settings.[11,15,16] Furthermore, the prognostic value of readily obtainable clinical parameters such as tachycardia, oxygen saturation, and routine biochemical indices remains incompletely characterized in this population.

This study therefore evaluated the clinical characteristics, laboratory findings, and predictors of mortality among patients with severe COVID-19 admitted to the intensive care unit of a specialist hospital in Lagos, Nigeria.

METHODS

Study design and setting

This was a retrospective descriptive study conducted among patients admitted with severe coronavirus disease 2019 (COVID-19) to the Intensive Care Unit (ICU) of First Cardiology Consultants Hospital, Lagos, Nigeria. The hospital is a specialist tertiary healthcare facility that provided intensive care services for patients with severe COVID-19 during the pandemic.

Study population

The study included all adult patients with laboratory-confirmed COVID-19 who were admitted to the ICU during the study period and whose medical records contained complete clinical and laboratory information required for the analysis.

Patients with incomplete medical records or insufficient clinical data were excluded from the study.

Data collection

Data were extracted retrospectively from patients' medical records using a structured data collection form. The information collected included:

- socio-demographic characteristics;
- presenting symptoms and clinical features;
- oxygen saturation at presentation;
- vital signs, including pulse rate;
- pre-existing comorbidities;

- laboratory investigations;
- treatment outcomes (discharge or death).

Laboratory parameters evaluated included serum urea, creatinine, alanine aminotransferase (ALT), aspartate aminotransferase (AST), alkaline phosphatase (ALP), C-reactive protein (CRP), ferritin, and D-dimer.

Renal dysfunction was defined by elevated serum urea and/or creatinine, while hepatic dysfunction was defined by elevated liver enzyme levels.

Data management and statistical analysis

Following anonymisation, the dataset was cleaned by removing incomplete records and cases that did not satisfy the study inclusion criteria. Statistical analysis was performed IBM SPSS Statistics version 25.0.

Continuous variables were expressed as mean ± standard deviation or median (interquartile range), as appropriate, while categorical variables were summarized as frequencies and percentages. Comparisons between survivors and non-survivors were performed using the independent *t*-test for continuous variables and the Chi-square test or Fisher's exact test for categorical variables, where appropriate.

Variables that showed significant associations with mortality on univariate analysis were entered into a multivariable logistic regression model to identify independent predictors of mortality. Odds ratios (ORs) with 95% confidence intervals (CIs) were calculated, and a *p*-value <0.05 was considered statistically significant.

Ethical consideration

Approval for the study was obtained from the ethics committee of Lagos University Teaching Hospital (Reference number: ADM/DSCST/HREC/APP/4484). Patient confidentiality was maintained throughout the study by anonymising all extracted data, and only authorized investigators had access to the study database.

RESULTS

A total of 35 patients with severe COVID-19 admitted to the intensive care unit were included in the study. Males constituted 28 (80.0%) of the patients, giving a male-to-female ratio of 4:1. The mean age was 58.4 ± 13.5 years, with over one-half (54.3%) aged 45–64 years, while 34.3% were aged 65 years or older. Overall mortality was 14.3% (5 patients), whereas 30 (85.7%) patients were discharged alive. Most patients (62.9%) presented with oxygen saturation below 95%. Hypertension (60.0%) and diabetes mellitus (48.6%) were the commonest comorbidities, while dyslipidaemia, peptic ulcer disease, hyperthyroidism, asthma, chronic kidney disease, hepatitis B infection, prostate cancer, benign prostatic hypertrophy, obstructive sleep apnoea, thymoma, and dementia occurred less frequently. Table 1 summarizes the demographic and clinical characteristics of the patients.

Table 1: Clinical Characteristics of the Patients

Variable	Frequency	Percentage (%)
Male	28	80
Females	7	20
≥ 65 years	12	34
45 -64 years	19	54.3
<45 years	4	11.4
SPO2 ≥95%	13	37.1
SPO2 90-94%	9	25.7
SPO2 <90%	13	37.1
Hypertension	21	60
Diabetes Mellitus	17	48.6
Dyslipidemia	5	14.3
Peptic ulcer	3	8.6
Hyperthyroidism	2	5.7
Asthma	1	2.9
Prostate cancer	1	2.9
Benign Prostatic Hypertrophy	1	2.9
Obstructive sleep apnea	1	2.9
Thymoma	1	2.9
Hepatitis B infection	1	2.9
Dementia	1	2.9
Chronic Kidney disease	1	2.9
Death	5	14.3
Discharged	30	85.7

Table 2: Presenting symptoms of patients with COVID-19 infection

Variable	Frequency	Percentage (%)
Fatigue	24	68.6
Breathlessness	23	65.7
Fever	22	62.8
Cough	19	54.3
Diarrhoea	10	28.6
Chest pain	9	25.7
Anosmia	9	25.7
Muscle pain	8	22.9
Headache	7	20
Loss of taste	5	14.3
Confusion	5	14.3
Sore throat	4	11.4
Insomnia	2	5.7
Coma	2	5.7

The most frequently reported presenting symptoms were fatigue (68.6%), breathlessness (65.7%), fever (62.8%), and cough (54.3%). Other symptoms included diarrhoea (28.6%), chest pain (25.7%), anosmia (25.7%), myalgia (22.9%), headache (20.0%), loss of taste (14.3%), confusion (14.3%), sore throat (11.4%), insomnia (5.7%), and coma (5.7%) (Table 2).

Among the five patients who died, four (80.0%) were aged 65 years or older, four (80.0%) had oxygen saturation below 90%, and all had tachycardia, hypertension, elevated alanine aminotransferase (ALT), elevated ferritin, elevated C-reactive protein (CRP), and breathlessness at presentation. Renal dysfunction, evidenced by elevated serum urea and creatinine, was present in four (80.0%) of the non-survivors. Diabetes mellitus, fever, fatigue, and elevated aspartate aminotransferase (AST) were present in 80.0%, while cough occurred in 60.0% of those who died (Table 3).

Comparison of laboratory and clinical parameters between survivors and non-survivors showed that patients who died had significantly higher mean D-dimer (p=0.001), CRP (p=0.018), pulse rate (p=0.008), serum urea (p=0.001), serum creatinine (p=0.010), and ALT (p=0.034) levels. Although non-survivors also had lower oxygen saturation and higher serum ferritin and AST levels, these differences did not reach statistical significance (Table 4).

On univariate analysis, age ≥65 years (p=0.024), oxygen saturation <95% (p=0.024), tachycardia (p=0.004), hypertension (p=0.043), renal dysfunction (p=0.032), and hepatic dysfunction (p=0.012) were significantly associated with mortality. Gender, diabetes mellitus, cough, fever, breathlessness, fatigue, and chest pain were not significantly associated with death (Table 5).

Table 3: Clinical and biochemical characteristics of COVID-19 patients with mortality

Variable	Frequency	Percentage (%)
Male	4	80
Females	1	20
≥ 65years	4	80
45-65 years	1	20
< 45 years	0	0
SPO2 ≥ 95%	0	0
SPO2 90-94%	1	20
SPO2 <90%	4	80
Tachycardia	5	100
Hypertension	5	100
Diabetes Mellitus	3	60
Breathlessness	5	100
Fatigue	4	80
Fever	4	80
Cough	3	60
Coma	2	40
Chest pain	1	20
Anosmia	1	20
Diarrhea	1	20
Sore throat	0	0
Loss of taste	0	0
Elevated Creatinine	4	80
Elevated Urea	4	80
Elevated AST	4	80
Elevated ALT	5	100
Elevated ALP	2	40
Elevated Ferritin	5	100
Elevated CRP	5	100

ALT- Alanine aminotransferase ; AST- Aspartate aminotransferase; ALP-Alkaline phosphatase; CRP- C-reactive protein

Table 4: Relationship between biochemical parameters and clinical outcomes

Parameter	Dead or Alive	Mean	Std Deviation	P value
SPO2 (%)	Discharged	90.67	10.042	
	Dead	81.6	6.387	0.063
D- Dimer mg/I	Discharged	2.051	2.641	
	Dead	9.787	8.296	**0.001**
CRP mg/I	Discharged	104.055	88.157	
	Dead	223.6	153.645	**0.018**
Ferritin Mcg/I	Discharged	3250.05	5340.925	
	Dead	4809.4	5210.799	0.553
Pulse rate Beats/min	Discharged	91.19	15.744	
	Dead	112.6	6.693	**0.008**
Urea Mg/dI	Discharged	49.83	47.213	
	Dead	141.2	76.054	**0.001**
Creatinine Mg/dI	Discharged	1.3621	1.8241	
	Dead	3.852	2.3066	**0.01**
ALT	Discharged	59.96	77.774	
	Dead	119.4	49.947	**0.034**
AST	Discharged	63.42	59.423	
	Dead	111	50.695	0.105

ALT- Alanine aminotransferase ; AST- Aspartate aminotransferase; CRP- C-reactive protein

Table 5: Relationship of clinical features with outcomes

Parameters	Discharged N (%)	Death N (%)	Total	X	P value
Age group /<65 years	22 (95.7)	1 (4.3)	23 (100)		
≥ 65 years	8 (66.7)	4 (33.3)	12 (100)	5.105	**0.024**
Gender / Female	6 (85.7)	1 (14.3)	7 (100)		
Male	24 (85.7)	4 (14.3)	28 (100)	0.004	0.947
Cough/ Yes	16 (84.2)	3 (15.8)	19 (100)		
No	16 (88.9)	2 (11.1)	18 (100)	0.173	0.677
Fever/ Yes	18 (81.8)	4 (18.2)	22 (100)	2.543	0.111
No	12 (92.3)	1 (7.7)	13 (100)		
Breathlessness/ Yes	18 (78.3)	5 (21.7)	23 (100)		
No	12 (100)	0 (0.0)	12 (100)	2.903	0.088
Fatigue/ Yes	20 (83.3)	4 (16.7)	24 (100)		
No	10 (90.9)	1 (9.1)	11 (100)	0.262	0.609
Chest pain/ Yes	8 (88.9)	1 (11.1)	9 (100)		
No	22 (84.6)	4 (15.4)	26 (100)	0.145	0.704
SPO2/ < 95%	9 (69.2)	4 (30.8)	13 (100)		
≥ 95%	21 (95.5)	1 (4.5)	22 (100)	5.13	**0.024**
Tachycardia/ ≤ 100 beats/ min	22 (100.0)	0 (0.0)	22 (100)		
> 100 beats/ min	6 (54.5)	5 (45.5)	11 (100)	8.504	**0.004**
Diabetes Mellitus/ Yes	14 (82.40)	3 (17.6)	17 (100)		
No	16 (88.9)	2 (11.1)	18 (100)	0.394	0.53
Hypertension/ Yes	16 (76.2)	5 (23.8)	21 (100)		
No	14 (100.0)	0 (0.0)	14 (100)	4.103	**0.043**
Renal dysfunction / Yes	9 (69.2)	4 (30.8)	13 (100)		
No	21 (95.5)	1 (4.5)	22 (100)	4.589	**0.032**
Hepatic dysfunction/ Yes	3 (50.0)	3 (50.0)	6 (100)		
No	27 (93.1)	2 (6.9)	29 (100)	6.31	**0.012**

Multivariable logistic regression demonstrated that tachycardia was the only independent predictor of mortality (adjusted OR = 0.831; 95% CI: 0.702–0.984; *p*=0.031). Although age ≥65 years showed borderline statistical significance (*p*=0.050), hypertension, diabetes mellitus, oxygen saturation, and fatigue were not independent predictors after adjustment for potential confounders (Table 6).

Table 6: Predictors of mortality in COVID-19

Variable	Adjusted OR	C.I	P value
> 65 years	0.985	0.010-0.887	0.05
Hypertension	0.515	0.370-0.717	0.998
Diabetes Mellitus	0.399	0.036-4.398	0.453
Tachycardia	0.831	0.702-0.984	**0.031**
SPO2	0.188	0.008-1.659	0.118
Fatigue	3.162	0.0231-43.355	0.389

DISCUSSION

The present study showed that most patients with COVID-19 admitted to the intensive care unit (ICU) had pre-existing comorbidities, particularly hypertension and diabetes mellitus. Approximately 60% of the patients were hypertensive, while over 40% had diabetes mellitus. This finding is consistent with the global pattern reported in previous studies.[1,6,12] Similarly, Dawei Wang *et al.*[12] reported that 58% of patients admitted to the ICU were hypertensive. Patients with poorly controlled comorbidities were more frequently represented among ICU admissions, highlighting the importance of optimal management of chronic non-communicable diseases. Comorbidities not only adversely affect quality of life and long-term survival but also increase susceptibility to severe disease during epidemics and pandemics.[12] These findings reinforce the need for effective prevention, early diagnosis, and adequate control of hypertension, diabetes, and other chronic diseases.

The presence of comorbidities has consistently been associated with increased mortality among patients with COVID-19.[11–13] This trend was also observed in the present study, where mortality occurred predominantly among elderly patients and those with multiple comorbidities. All patients who died had hypertension and multiorgan dysfunction involving at least three organ systems, while 80% were elderly and 60% had diabetes mellitus. Similar associations between advanced age, hypertension, diabetes, multiple comorbidities, and poor outcomes have been reported by several authors.[10–12,14–16] In a large multicentre study involving over 2,000 patients admitted to isolation facilities in Lagos State, Osibogun A *et al.*[15] identified hypertension, diabetes, and other comorbidities as significant predictors of mortality. They further demonstrated that patients with two or more comorbidities had a substantially higher risk of death than those with a single comorbidity. Similar findings were reported by Abayomi A *et al.*[16]

COVID-19 is known to produce more severe disease in individuals with hypertension, diabetes, and other chronic non-communicable diseases.[5,10] These patients are more susceptible to cardiovascular complications, including myocarditis, cerebrovascular accidents, arrhythmias, and myocardial infarction, all of which are associated with increased mortality. Consequently, appropriate cardiovascular risk assessment and cardioprotective strategies should form an integral component of the management of high-risk patients with COVID-19.

Severe COVID-19 requiring ICU admission is characterized by an exaggerated systemic inflammatory response with elevated inflammatory biomarkers and an increased risk of death. This pattern was evident in the present study, where all patients who died had elevated serum C-reactive protein (CRP) and ferritin levels, which were significantly higher than those of survivors. The cytokine storm syndrome associated with severe COVID-19 results in overwhelming inflammation, rapid clinical deterioration, and poorer

outcomes.[5,10,12,17] Cytokine storm occurs more frequently among elderly patients and those with underlying comorbidities, partly explaining the higher mortality observed in these groups.[10,12,17]

The mortality rate in the present study was 14.3%, and all patients who died had hypertension, tachycardia, and hypoxaemia. This mortality rate was higher than the 3.3% reported by Osibogun A *et al.*[15], probably because most patients in their study had mild disease, whereas all patients in the present study were critically ill and required ICU admission. However, our mortality rate was considerably lower than those reported from many intensive care units in Europe and North America.[5,10,11,13] Possible explanations include the relatively younger age of our study population, previous exposure to endemic coronaviruses with potential cross-immunity, and greater sunlight exposure with higher endogenous vitamin D production.[18] Previous studies have suggested that Africa's younger population structure contributed substantially to the lower COVID-19 mortality observed across the continent.[15,18]

Furthermore, pre-existing innate and cross-reactive immunity following exposure to other coronaviruses may reduce disease severity.[18,19] Vitamin D has also been reported to enhance innate immunity, modulate inflammatory responses, suppress excessive cytokine production, and regulate the renin-angiotensin system, thereby potentially reducing disease severity and improving clinical outcomes.[20–25] Although these mechanisms remain plausible, they should be interpreted cautiously because they were not directly evaluated in the present study.

Patients who died also had significantly lower oxygen saturation, with 80% presenting with SpO_2 <90% and the remaining 20% with SpO_2 between 90% and 94%. These findings reflect severe pulmonary inflammation and extensive lung involvement. Similar observations have been reported among critically ill patients with COVID-19 requiring ICU admission.[5,10,12] Severe pulmonary inflammation results in hypoxaemia, which in turn exacerbates tissue hypoxia, systemic inflammation, myocardial injury, cerebrovascular events, arrhythmias, and multiorgan dysfunction, thereby contributing to increased morbidity and mortality.

An important but relatively under-recognised prognostic factor observed in this study was tachycardia. Tachycardia reflects increased sympathetic activity and physiological stress and is commonly encountered in both communicable and non-communicable diseases.[26–28] Patients who died had significantly higher heart rates than survivors. This may be attributable to several factors, including fever, hypoxaemia, anaemia, dehydration, electrolyte imbalance, anxiety, and sympathetic overactivity. Diarrhoea, which occurred in more than one-quarter of patients, may also have contributed through dehydration and electrolyte disturbances. Persistent tachycardia increases myocardial oxygen demand and may predispose patients to myocardial ischaemia, malignant arrhythmias, and haemodynamic instability. Previous studies have demonstrated that appropriate heart rate control is associated with improved clinical outcomes in critically ill patients.[28,29]

This study has some limitations. As a retrospective study, incomplete medical records resulted in the exclusion of some patients, thereby reducing the sample size. In addition, the study was conducted in a highly specialised private tertiary hospital, where the cost of care may have limited access for many critically ill patients. Consequently, the study population may not fully represent all patients with severe COVID-19 in the community.

The relatively small sample size may also have contributed to the wide confidence intervals observed in some analyses. Nevertheless, studies conducted in government-owned treatment centres have reported similar associations between comorbidities and disease outcomes, supporting the validity of our findings.[15,16] The comparatively lower mortality observed in our cohort may also reflect the benefits of specialised multidisciplinary care in a high-

resource, low-patient-density hospital environment.

Another limitation is the possibility of underreporting of comorbidities because much of the information was obtained from patients or their relatives. Furthermore, potentially important confounding variables, including COVID-19 vaccination status, socioeconomic status, and the adequacy of pre-admission control of chronic diseases, were not available. Future multicentre prospective studies incorporating these variables would provide a more comprehensive assessment of predictors of mortality among critically ill patients with COVID-19.

CONCLUSION

The majority of patients with COVID-19 admitted to the ICU had pre-existing comorbidities, particularly hypertension and diabetes mellitus. Hypertension, tachycardia, hypoxaemia, renal dysfunction, hepatic dysfunction, and elevated inflammatory markers were associated with increased mortality. Early identification and optimal control of chronic comorbidities, together with prompt recognition and aggressive management of critically ill patients, may improve outcomes. Public health interventions should therefore prioritise screening for high-risk comorbidities, improve awareness, and promote effective long-term management of chronic diseases to reduce the burden of severe COVID-19.

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AUTHORS' CONTRIBUTIONS: Dr Olusegun-Joseph and Dr Johnson conceived and designed the study to document the centre's experience, challenges, and outcomes in the management of critically ill patients with COVID-19. Data collection was undertaken by Dr Nkanor and Dr Oladunjoye using anonymised patient records that included demographic characteristics, presenting symptoms, disease severity, medical history, comorbidities, laboratory investigations, and clinical outcomes. Data cleaning and analysis were performed by Dr Nkanor, Dr Oladunjoye, and Dr Okunowo, including the exclusion of incomplete records and cases that did not meet the inclusion criteria. Statistical analysis was conducted by a statistician in collaboration with Dr Okunowo using SPSS version 25. Dr Olusegun-Joseph prepared the initial manuscript draft, while all authors critically reviewed the manuscript, approved the final version, and accept responsibility for its content.

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