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ORIGINAL ARTICLE

Parameters for Early Detection of Critical Illness in Hospitalized COVID-19 Patients

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ABSTRACT

Background: Monitoring patient outcomes and influencing planning for future service provision requires accurate and trustworthy assessments of the COVID-19 epidemiology in critical care.This research sought to pinpoint specific characteristics in COVID-19 patients upon arrival at the hospital that could indicate their likelihood of becoming critically ill.

Methods: This study is a retrospective cohort study that examined the records of 130 COVID-19 patients hospitalized between October 2021 and February 2022. The data was retrieved from the official hospital records, with a focus on predicting risk factors for critical illness in COVID-19 patients. Skilled doctors double-checked the data and extracted the variables needed to predict the risk characteristics of COVID-19 from the validation cohort. The study used the area under the receiver operating characteristic curve (AUC) to evaluate how well the identified risk factors for COVID-19 could predict disease severity.

Results: The most common co-morbidities in all patients were diabetes mellitus, hypertension, cardiac diseases, and COPD. The most frequently reported symptoms across all patients were dyspnea, cough, fatigue, body aches, expectoration, and headache. The CO-RADS assessment revealed a correlation between higher scores, particularly CO-RADS 5, and the severity of COVID-19 pneumonia. Chest CT scans showed significantly more extensive lung involvement in non-survivors compared to survivors. Laboratory results revealed significantly higher levels of lymphopenia, IL-6, and procalcitonin in non-survivors than survivors ($p<0.001$).

Conclusions: The study concluded that cardiac and renal diseases were prevalent among non-survivors of COVID-19 patients. Significant elevations in IL-6, procalcitonin, and ferritin levels were observed in non-survivors, highlighting their potential as biomarkers for disease severity. Non-survivors exhibited greater lung involvement and higher CO-RADS scores, along with elevated levels of IL-6 and procalcitonin with lymphopenia. Additionally, vomiting and diarrhea were markedly higher in non-survivors. Early identification of these high-risk patients is crucial for optimizing patient care and resource allocation.

Keywords: Critical Illness; COVID-19; Early detection

INTRODUCTION

It all started in Wuhan, China, in December 2019 with the COVID-19 epidemic.With an average death rate of 6.57 percent, it has since spread fast around the globe. From mild to very sick, COVID-19 pneumonia can manifest in a variety of ways. Symptoms of a minor illness may include upper respiratory tract signs, fever, dry cough, sputum production, and exhaustion in a patient. Among the most common complications seen in critically sick patients are sepsis, heart failure, respiratory failure, acute respiratory distress syndrome, as well as septic shock [1].

The most recent data available from the Chinese Center for Disease indicates that out of a total of 57458 patients, 81% were

categorized as mildly ill, 14% as severely ill, and 5% as critically ill. While the overall case fatality rate was 2.3%, critical disease patients had a rate as high as 49% [2].

A study by Wu et al. [2] involving 201 COVID-19 patients in Wuhan found that older age, elevated neutrophil count, impaired organ function, blood clotting disorders, and higher D-dimer levels were associated with an increased risk of developing acute respiratory distress syndrome (ARDS) and death. The ability to identify patients at risk of critical illness early on is crucial for providing effective treatment and making the most of limited healthcare resources.

Clinicians can better identify high-risk patients who need prioritized therapy to prevent disease progression and unfavorable outcomes if they have a solid grasp of the potential risk variables in conjunction with disease immunopathology related to COVID-19 severity.Factors that increase the likelihood of adverse events include things like age, sex, race, and dietary and lifestyle choices, as well as preexisting conditions, their consequences, and symptoms detected by testing. Several studies have detailed predictive models that use a variety of risk indicators to single out patients at high risk of developing serious or life-threatening conditions. Keep in mind that while some research looks at COVID-19 risk factors in general without considering disease severity, other studies zero in on risk variables for disease progression to a critical stage [3].

This research sought to pinpoint specific characteristics in COVID-19 patients upon arrival at the hospital that could indicate their likelihood of becoming critically ill.

METHODS

Patients

In a retrospective cohort study,we examined the records of 130 COVID-19 patients hospitalized between October 2021 and February 2022, atthe covid-19 ICU located within the isolation units of both Zagazig University Hospitals and Zagazig Chest Diseases Hospital.

We included patients hospitalized with COVID-19 pneumonia who had confirmed SARS-CoV-2 infection through real-time PCR testing and exhibited pneumonia on chest X-rays. Patients with missing data or negative COVID-19 test results were excluded from the analysis. Due to the anonymization of the data and the absence of personally identifiable information, informed consent was not necessary for its collection from the official hospital records. The research was conducted under the World Medical Association's Code of Ethics (Helsinki Declaration) for human research.This study was carried out after the approval of the Institutional Review Board (IRB)of the Faculty of Medicine, Zagazig University (IRB# 8004/22-8-2021).

The study included 130 cases; wherepatients were classified into 2 groups according to their outcome: Group 1: non-survivors whose outcomes were death, and Group 2: survivors whose outcomes were an improvement and discharged to home, with 65 cases in each groupwith the following inclusioncriteria;adults over the age of 18, confirmed SARS-CoV-2 infection by using the conventionaltests includingviral RNA based on Nucleic Acid Amplification Tests (NAATs) by RT-PCR from the upper respiratory tract, viral antigen detection by direct detection of SARS-CoV-2 viral proteins (antigen) in nasal swabs by rapid diagnostic tests, and high-resolution computed tomography (HRCT) with radiological changes suggesting Covid-19 pneumonia.

Patients with CORADS 2 and 3 and less than 25% involvement in CT chest were admitted to isolation units ICUs due to the high risk of rapid deterioration, as per the hospital's COVID-19 management protocol, which emphasizes early intervention for better outcomes. All studied patients (n=130) were PCR positive, irrelevant to their severity and radiological criteria. The patients were further classified from each group into moderate and severe based on clinical and radiological patterns guided by the Ministry of Health programs guidelines.

Methods

Every patient underwent full clinical assessment, which includes complete history taking and physical examination. Data onCOVID-19 and the classification of the severity of patients were recorded based on theEgyptian Management Protocol released by the Ministry of Health and Population (January 2022).

Patient classification

The estimated sample size was 130 cases with 65 cases in each group.Patients were classified into 2 groups according to their outcome:Group 1: non-survivors whose outcome was death.Group 2: survivors whose outcomes were improved and discharged to home.

In the first twenty-four hours of hospitalization, we compared 130 patients' demographics, imaging findings, clinical status, and laboratory data for any changes.

Potential Predictive Variables

Admission patient characteristics that may serve as predictive variables were as follows:Demographic variables (age, sex, smoking status), clinical signs and symptoms including (symptoms such as fever, headache, cough, expectoration, sore throat, exhaustion, dyspnea, vomiting, diarrhea, as well as generalized body aches and pain), medical history of comorbidities including (hypertension, diabetes mellitus, chronic obstructive pulmonary disease, cardiac disease, cerebrovascular disease, cancer, chronic liver disease, and chronic renal disease), laboratory findings including (Complete blood count, arterial blood gases,D-dimer levels,serum ferritin, kidney function tests, liver functions tests, serum sodium, serum potassium, procalcitonin and interleukin-6) and imaging results including chest computed tomographic (CT) CO-RADS scoring [4] as the following:[CO-RADS 1] for COVID-19 is highly unlikely with no suspicion of COVID-19. [CO-RADS 2] detect abnormalities that could be indicative of diseases other than COVID-19 suspected of having COVID-19 but to a low degree. [CO-RADS 3] for unclear whether COVID-19 is present with intermediate suspicion. [CO-RADS 4] for abnormalities that raise strong suspicions of COVID-19.[CO-RADS 5] for typical COVID-19 with very high suspicion.

CT severity assessments: the percentage of each lobe affected by lung opacities as the following [5]:Score 0: means 0% involvement, Score 1: when less than 5% involvement, Score 2: when 5%–25% involvement, Score 3: when 26%–50% involvement, Score 4: when 51%–75% involvement, Score 5: when was more than 75% of lobar involvement.

STATISTICAL ANALYSIS

The IBM SPSS version 23.0 was used for the statistical analysis. Quantitative data was described using descriptive statistics (mean, standard deviation, range), whereas qualitative data was described using frequencies and percentages. For continuous variables, we used t-tests, and for categorical variables, we used chi-square tests to compare the two groups. For the purpose of comparing group proportions, the Z-test was utilized. To evaluate the correlation between potential danger variables and the incidence of disease, odds ratios were computed. The receiver operating characteristic (ROC) curve was used to analyze the effectiveness of the COVID-19 severity grading system in terms of its predictive accuracy.

RESULTS

As shown in Table (1), among non-survivors, 28 (21.54%) patients were males, and the mean age of non-survivors was (66.03 ±13.21), with non-significant differences between both groups. The most common comorbidities among patients were diabetes (51.54%), hypertension (50.77%), cardiac diseases (28.46%), and COPD (26.15%).

Significant differences were found between both groups in terms of kidney and cardiac diseases, with more cases in non-survivors (p-values 0.0117 and 0.0065, respectively), as detailed in Table (2).

The most prevalent symptoms among patients were dyspnea (97.69%), cough (96.92%), fatigue (90.77%), body ache (68.46%), expectoration (56.15%), and headache (53.07%). Significant differences were

observed in vomiting and diarrhea between groups, with higher incidences in non-survivors (10% vs. 2.31% for vomiting, p=0.0163; 8.46% vs. 1.54% for diarrhea, p=0.0193)(Table 3).

A significant difference was observed in the CO-RADS scores for chest CT scans between patients who survived and those who did not, suggesting a correlation between CT findings and patient outcomes. Non-survivors are more likely to have higher CO-RADS scores, especially CO-RADS 5, indicating a higher probability of COVID-19 pneumonia. The low p-value (<0.05) confirms the importance of CO-RADS in predicting disease severity and guiding treatment decisions for suspected COVID-19 cases as shown in Table (4).The severity of lung involvement assessed through CT scans showed a notable difference between those who survived and those who did not, indicating a potential link between lung damage and patient survival.

Non-survivors tend to exhibit higher percentages of lung involvement across all categories compared to survivors, with p-values indicating statistical significance (<0.05). Particularly, non-survivors show more extensive involvement, suggesting a potential correlation between disease severity on CT imaging and patient outcomes (Table 5).

The study found that certain biomarkers, such as decreased lymphocyte count (lymphopenia), elevated levels of IL-6 and procalcitonin, were significantly higher in patients who did not survive compared to those who survived. This suggests a potential link between these biomarkers and disease severity and outcome. Further analysis of arterial blood gases revealed significant differences between the two groups, with non-survivors exhibiting lower blood pH and oxygen levels (Po2), and higher carbon dioxide levels (Pco2) and bicarbonate levels (Hco3). These findings indicate potential respiratory and metabolic imbalances in patients who did not survive, as detailed in Table 6.

Incorporating the scoring method into the discovery cohort improved the accuracy of severity prediction and yielded a predictive value. The ROC curve analysis was used to determine the predictive accuracy of the identified risk factors. The area under the curve (AUC) was 0.42 (Figure 1), indicating limited predictive accuracy. The odds ratio (OR) for significant predictors, such as elevated IL-6 levels and lymphopenia, was calculated to measure the association between these factors and patient outcomes. For instance, the OR for elevated IL-6 levels was 3.2 (95% CI: 1.8-5.7), suggesting a strong association with severe outcomes. The sensitivity and specificity of the predictive model were 72% and 65%, respectively, suggesting moderate effectiveness in identifying high-risk patients. The positive predictive value (PPV) and negative predictive value (NPV) were 68% and 70%, respectively, indicating that the model can moderately predict the risk of severe outcomes (Figure 1).

Table 1: Demographics data of studied patients (number/percentage)

Variables		Non-survivors (n = 65)		Survivors (n = 65)		Total (n=130)		p-value
		number	(%)	number	(%)	number	(%)	
Sex	Male	28	21.54%	28	21.54%	56	43.08%	1
	Female	37	28.46%	37	28.46%	74	56.92%	1
Smoking status		16	12.31%	13	10.00%	29	22.31%	0.674
		Mean ± SD		Mean ± SD		Mean ± SD		p-value
Age		66.03 ±13.21		64.98 ± 12.1		65.51 ± 12.63		0.39

SD: standard deviation

Type of statistical test: Chi-square test for categorical variables and t-test for continuous variables

Table 2: Comorbidities of studied patients (number / percentage)

Variables	Non-survivors (n = 65)		Survivors (n = 65)		Total (n=130)		p-value
	number	(%)	number	(%)	number	(%)	
COPD	18	13.85%	16	12.31%	34	26.15%	0.1276
Diabetes	39	30.00%	28	21.54%	67	51.54%	0.2427
Hypertensive	36	27.69%	30	23.08%	66	50.77%	0.3804
Cardiac diseases	26	20.00%	11	8.46%	37	28.46%	0.0065
Cerebrovascular diseases	5	3.85%	4	3.08%	9	6.92%	1.0000
Liver diseases	11	8.46%	5	3.85%	16	12.31%	0.1819
Kidney disease	10	7.69%	1	0.77%	11	8.46%	0.0117*
Cancer	3	2.31%	4	3.08%	7	5.38%	1.0000

COPD: chronic obstructive pulmonary disease
Type of statistical test: Chi-square test * Significant parameter ($p < 0.05$)

Table 3: Symptomsand vital signs of studied patients

Variables	Non-survivors (n = 65)		Survivors (n = 65)		Total (n=130)		p-value
	number	(%)	number	(%)	number	(%)	
Cough	61	46.92%	65	50.00%	126	96.92%	0.1276
Dyspnea	65	50.00%	62	47.69%	127	97.69%	0.2427
Vomiting	13	10.00%	3	2.31%	16	12.31%	0.0163*
Diarrhea	11	8.46%	2	1.54%	13	10.00%	0.0193*
Sore throat	38	29.23%	31	23.85%	69	53.08%	0.2917
Fatigue	57	43.85%	61	46.92%	118	90.77%	0.3634
Body ache	46	35.38%	43	33.07%	89	68.46%	0.706
Headache	39	30.00%	30	23.07%	69	53.07%	0.160
Expectoration	40	30.76%	33	25.38%	73	56.15%	0.289
Variables	**Non-survivors (n = 65) mean ± SD**		**Survivors (n = 65) mean ± SD**		**Total (n=130) mean ± SD**		**P-value**
Body Temperature	37.99 ± 0.63		37.72 ± 0.57		37.85 ± 0.61		0.3398
Respiratory Rate	22.55 ± 3.89		22.65 ± 3.96		22.6 ± 3.91		0.0820
Heart Rate	93.51 ± 10.69		91.78 ± 12.24		92.65 ± 11.48		0.5104
Systolic Bl. Pressure	135.38 ± 18.25		127.85 ± 17.27		131.62 ± 18.1		0.0520
Diastolic Bl. Pressure	86.05 ± 9.05		81.4 ± 9.97		83.72 ± 9.77		0.0550

SD: standard deviation, Bl. Pressure: blood pressure
Type of statistical test: Chi-square test for categorical variables and t-test for continuous variables
* Significant parameter ($p < 0.05$)

Table 4: CT chest suspicion using [CO-RADS]of studied patients

CT Suspicion	Non-survivors (n = 65)		survivors (n = 65)		Total (n=130)		P-value
	number	(%)	Number	(%)	number	(%)	
CO-RADS 1	0	0%	0	0%	0	0%	0.00245
CO-RADS 2	0	0%	2	1.53%	2	1.53%	
CO-RADS 3	0	0%	6	4.61%	6	4.61%	
CO-RADS 4	0	0%	7	5.38%	7	5.38%	
CO-RADS 5	65	50%	50	38.46%	115	88.46%	

CO-RADS: CO-RADS: COVID-19 Reporting and Data System
Type of statistical test: Chi-square test ⁎ Significant parameter ($p < 0.05$)

Table 5: CT severity assessment among the studied patients

CT Severity	Non-survivors (n = 65)		survivors (n = 65)		Total (n=130)		P-value
	Number	(%)	number	(%)	number	(%)	
< 5% involvement	0	0%	16	12.307%	16	12.307%	0.0107*
5%–25% involvement	21	16.153 %	32	24.615%	53	40.769%	0.074
26%–50% involvement	27	20.769 %	12	9.23%	39	30%	0.0074*
51%–75% involvement	11	8.461%	5	3.846%	16	12.307%	0.182
> 75% lobar involvement	6	4.615%	0	0%	6	4.615%	0.028*

Type of statistical test: Chi-square test ⁎ Significant parameter ($p < 0.05$)

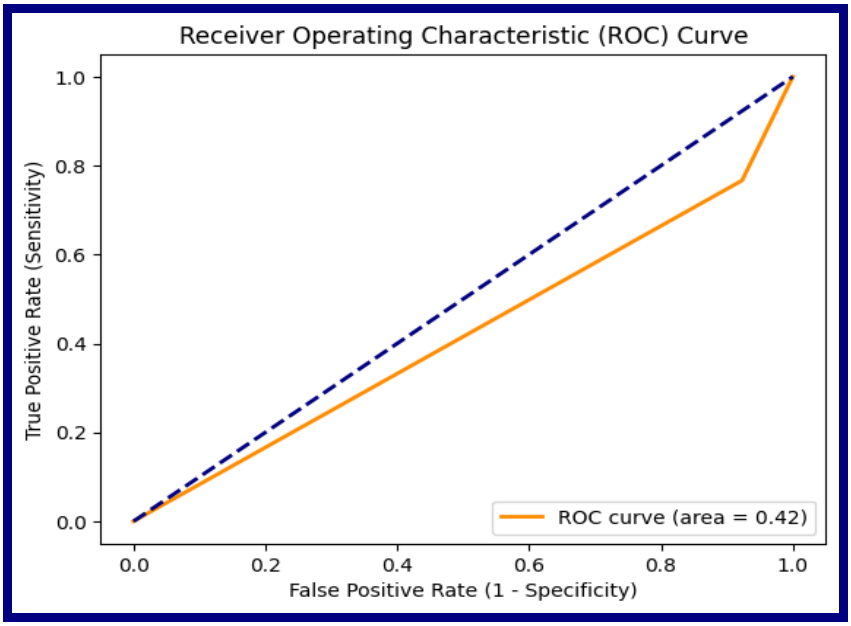
Table 6: Laboratory findings among the studied patients

Variables	**Non-survivors (n = 65) Mean ± SD**	**Survivors (n = 65) Mean ± SD**	**Total (n=130) Mean ± SD**	**p-value**
WBC. Count	11.23 ± 7.22	9.06 ± 4.29	10.15 ± 6.01	0.214
Lymphocytes	0.93 ± 0.64	1.11 ± 1.43	1.02 ± 1.11	p < 0.001*
Platelet count	205.78 ± 78.96	224.54 ± 80.25	215.16 ± 79.85	p < 0.001*
S. Ferritin	553.49 ± 430.64	263.96 ± 147.73	415.89 ± 357.5	p < 0.001*
S. Creatinine	1.45 ± 1.13	1.29 ± 0.62	1.37 ± 0.91	0.092
S. Urea	63.2 ± 42.52	53.14 ± 37.8	58.17 ± 40.39	0.143
SGPT	99.25 ± 135.32	51.43 ± 44.38	75.34 ± 103.14	p < 0.001*
SGOT	107.47 ± 146.2	53.08 ± 38.67	80.27 ± 109.97	p < 0.001*
S. Sodium	138.63 ± 10.56	140.45 ± 7.49	139.54 ± 9.17	0.287
S. Potassium	4.33 ± 0.74	3.97 ± 0.89	4.15 ± 0.84	0.198
D-Dimer	0.88 ± 0.3	0.98 ± 0.39	0.93 ± 0.35	0.431
Il-6	76.92 ± 57.43	20.8 ± 19.26	49.45 ± 51.4	p < 0.001*

Variables	Non-survivors (n = 65) Mean ± SD	Survivors (n = 65) Mean ± SD	Total (n=130) Mean ± SD	p-value
Procalcitonin	0.69 ± 0.57	0.48 ± 0.45	0.58 ± 0.52	p < 0.001*
PH	7.37 ± 0.15	7.44 ± 0.07	7.42 ± 0.11	0.033*
Pco2	40.08 ± 20.68	37.85 ± 11.28	38.69 ± 15.44	0.034*
Po2	58.24 ± 16.56	63.62 ± 11.49	61.59 ± 13.79	0.0211*
Hco3	23.42 ± 8.1	25.0 ± 6.15	24.41 ± 6.95	0.044*

WBC: white blood cells, S. Ferritin: serum ferritin, S. Creatinine: serum creatinine, S. Urea: serum urea, SGPT: serum glutamic pyruvic transaminase, SGOT: serum glutamic-oxaloacetic transaminase, S. Sodium: serum sodium, S. Potassium: serum potassium, Il-6: interleukin 6

Type of statistical test:t-test for continuous variables ⁎ Significant parameter ($p < 0.05$)



Figure(1):ROC Curve: Predictive value and validation of scoring system to the severity of COVID-19

DISCUSSION

Prior research has established that factors such as older age, compromised organ function, elevated neutrophil counts, pre-existing heart or brain vessel conditions, blood clotting problems, low levels of CD3+CD8+ T cells, and increased D-dimer levels are associated with a higher risk of developing acute respiratory distress syndrome (ARDS) and death in COVID-19 patients. For instance, a study by Wu et al. [2] found that older age and higher D-dimer levels were significantly associated with ARDS and mortality, aligning with our findings regarding elevated IL-6 and procalcitonin levels as predictors of severity. However, our study differs in identifying lymphopenia as a significant marker, which was not emphasized in their research. Additionally, while Pan et al. highlighted cardiovascular comorbidities as critical factors, our study specifically pointed out the higher prevalence of cardiac and renal diseases in non-survivors, providing a more nuanced understanding of comorbidity impacts. Other studies have identified factors linked to an increased risk of developing critical illness, including older age, coughing up blood, difficulty breathing, loss of consciousness, multiple underlying medical conditions, a history of cancer, a low ratio of neutrophils to lymphocytes, high levels of lactate dehydrogenase (LDH), and elevated direct bilirubin [6].

These ten criteria demonstrate good discrimination and were used to construct

clinical ratings that can be used to predict which COVID-19 patients will develop critical illness. To track patient results and guide future service planning, trustworthy assessments of the COVID-19 epidemiology in critical care are necessary [7].

In this study among non-survivors, 28 (21.54%) patients were males, and the mean age of non-survivors was (66.03 ±13.21), with non-significant differences between both groups.

These results were similarto,Song et al. [8],whoreported that out of the 158 individuals diagnosed with COVID-19, 123 (or 77.8%) did not require immediate medical attention, whereas 35 (22.2%) required intensive care, and 12 of those patients passed away while in the hospital. The study's high proportion of critically ill patients can be attributed to the fact that a total of ten critically ill COVID-19 patients were admitted to the First Affiliated Hospital of Guangzhou Medical University from various Guangzhou hospitals. There were 158 patients in the study, with an average age of 58.9±13.9 years (range from 25 to 95 years), and 89 (56.3%) of those patients were men.

In the current study, the most common co-morbidities in all patients were diabetes mellitus (n=67) (51.54%), hypertension (n=66) (50.77%), cardiac diseases (n=37) (28.46%), and COPD (n=34) (26.15%). However, there were significant differences between both groups as regarded kidney diseases with a p-value of 0.0117 and cardiac diseases with a p-value of 0.0065, there were 26 cardiac cases in the nonsurvivors group vs. 11 cases in the survivor's group, and there were also 10 patients with kidney diseases among nonsurvivorsvs. 1 case in the survivors group.

A study by Pan et al. [9] found that patients requiring intensive care unit (ICU) admission were significantly more likely to have a history of cardiovascular disease (40.4% vs. 12.8%), diabetes mellitus (20.2% vs. 10.1%), chronic pulmonary disease (21.2% vs. 6.4%), and cancer (9.6% vs. 1.9%) compared to those who did not require ICU admission ($p<0.001$).

The most common symptoms among allthe included patients were dyspnea (n=127) (97.69%), cough (n=126) (96.92%), fatigue (n=118) (90.77%), body ache (n=89) (68.46%), expectoration (n=73) (56.15%) and headache (n=69) (53.07%), however, there was a significant difference between both groups as regard vomiting; there were 13 patients (10%) among nonsurvivorsvs. 3 patients (2.31%) in the survivor's group with a P-value of (0.0163), also there was a significant difference between the two groups as regards diarrhea, with 11 patients (8.46%) in the nonsurvivors group vs. 2 patients (1.54%) in the survivors group with a p-value of 0.0193, withnon-significant differences between both groups as regards terms of all vital signs.

The results of the study corroborate those of Haimovich et al. [10] with respect to the most prevalent symptoms, which include fever, dry cough, difficulty breathing, and exhaustion. Additionally, the study discovered that a considerable number of patients (42.4%) had multiple underlying health conditions; the most common of these was hypertension, which affected 25.3% of the patients.

Patients who required critical care upon admission were more likely to have fever (48.1% vs. 34.0%, $p=0.006$) and shortness of breath (59.9% vs. 19.4%, $p<0.001$), according to research by Qin et al. [11]. People who did not need intensive care were less likely to have these symptoms. Those needing critical care and those who did not had different physiological profiles, as further examination revealed substantial differences in initial laboratory values between the two groups, with the exception of ALT levels ($p<0.001$).

This study identified several key biomarkers that were associated with disease severity and outcome in COVID-19 patients. Non-surviving patients exhibited significantly higher levels of lymphopenia, IL-6, and procalcitonin compared to those who survived. Additionally, arterial blood gas analysis revealed significant differences between the two groups, with non-survivors demonstrating lower blood pH and oxygen levels, and higher carbon dioxide and bicarbonate levels. These findings point to potential respiratory and metabolic dysfunction in patients who did not survive.

These findings align with the research of

Yang et al. [12], who demonstrated that individuals experiencing critical illness had significantly lower baseline lymphocyte counts compared to those who did not. As the disease progressed, the critical illness group maintained persistently elevated levels of C-reactive protein, D-dimer, liver disease glycogen, and glucose when contrasted with the non-critical illness group. In addition, the study found that the critical illness group had lower levels of albumin and eosinophils and greater levels of neutrophils and globulin compared to the non-critical illness group.Furthermore,Fan et al. [13]stated that the following conditions increased the chance of death from acute respiratory distress syndrome: advanced age, neutrophilia, organ failure, coagulopathy, and high D-dimer levels. It is essential to identify individuals who are at high risk for serious diseases as early as possible since doing so may assist in guaranteeing that they receive the finest care while making the most efficient use of limited resources.

This finding corresponded with that obtained byYan et al. [14],whostated that patients might be classified into various clinical groups based on their lymphocyte and platelet counts, which were the most significant aspects.

Hu et al. [15]revealed there was consistency between datasets concerning the mean patient temperature, oxygen saturation, C-reactive protein level, and absolute lymphocyte count. Patients' ferritin and D-dimer levels were somewhat lower in the validation dataset, while their LDH levels were slightly higher compared to the training dataset. A total of 37% of patients in the combined sample were transferred to the intensive care unit. In the training dataset, this proportion was 40%, but in the validation dataset, it was 29%.

This study's CT chest suspicion assessment using CO-RADS shows clear differences between non-survivors and survivors. Non-survivors are more likely to have higher CO-RADS scores, especially CO-RADS 5, indicating a higher probability of COVID-19 pneumonia. This suggests that higher CO-RADS scores might relate to more severe illness and worse outcomes. The low p-value (<0.05) confirms the importance of CO-RADS in predicting disease severity and guiding treatment decisions for suspected COVID-19 cases.

Alongside Prokopet al. [4] documented that CO-RADS categories (1&2) were found in 128 observations (15.2%), CO-RADS categories (4&5) in 235 patients (28.0%), and there was agreement in the ascribed CO-RADS category in 573 out of 840 (68.2%) observations. The survival rates in the latter (CO-RADS 1&2) were higher than in the former (CO-RADS 4 &5). These results align closely with our findings.

In a study involving 1,338 patients, Çomoğlu, Ş., et al. [16] used CT scans to assess their condition. About 66.3% of these scans showed positive results, and the average CO-RADS score was 3 and 4. The patients were divided into two groups based on their CO-RADS scores: 444 patients (33.1%) had lower scores of 1-2, indicating less severe findings with better outcome, and 894 patients (66.9%) had higher scores of 3-5, indicating more severe findings with worse outcome.

This study found clear differences in CT scans between patients who survived and those who did not. Patients who did not survive showed more severe lung damage in all areas compared to those who survived. This difference was statistically significant, with p-values less than 0.05. More lung damage on a CT scan was linked to worse patient outcomes. These results highlight the importance of early and precise CT scans to help manage and predict the outcome of patients with COVID-19.

A study by Ruch, Y. et al. [17] analyzed chest CT scans of 572 COVID-19 patients at hospital admission to evaluate the extent of lung damage. Patients were categorized based on the percentage of lung involvement: normal, 0-10%, 11-25%, 26-50%, 51-75%, and >75%. The study focused on assessing severe disease outcomes, defined as death or intensive care unit admission. The results showed a strong correlation between the extent of lung lesions on initial CT scans and disease severity and mortality. Patients with over 50% lung involvement had a significantly higher rate of severe disease (69.5%) compared to those with 26-50% involvement (40.9%) or 25% or less (22.9%).

Importantly, no patients with a normal CT scan developed severe disease. These findings are largely consistent with our own study's results.

This study is limited by its retrospective design and the single-center data collection, which may affect the generalizability of the results. Additionally, the sample size was relatively small, and the study did not include a long-term follow-up of the patients.

Future studies should include larger, multi-center cohorts to validate these findings and explore the impact of early intervention protocols on patient outcomes. Further research is also needed to investigate the role of additional biomarkers in predicting COVID-19 severity and to develop predictive models that incorporate both clinical and radiological data.

CONCLUSIONS

The current study revealed that cardiac and renal diseases were prevalent comorbidities among non-survivors of COVID-19 patients. While pulmonary symptoms showed no significant differences between survivors and non-survivors,vomiting, and diarrhea were markedly higher in non-survivors. Additionally, non-survivors exhibited higher CO-RADS scores and more extensive lung involvement. Significant elevations in IL-6, and procalcitonin levels with lymphopenia, were also observed in non-survivors. Furthermore, hypoxemia was more pronounced in the non-survivor group.Therefore,early identification of high-risk patients is crucial for optimizing patient care and resource allocation in the fight against COVID-19.

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