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Relationship Between Clinical and Computed Tomography Scan Severity of Pulmonary Infection in COVID-19 Patients Admitted to Intensive Care Unit: A Study from the National COVID-19 Hospital in Lomé, Togo

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Abstract

Aim: Lung injuries in patients with Coronavirus Disease 2019 (COVID-19) are often associated with severity scores. This study aimed to describe the relationship between clinical categorization and the severity of chest computed tomography (CT) scan features in a low-resource setting. This research adopted a retrospective, descriptive, and analytical study design to explore the data.

Study Design: The study was carried out in the Intensive Care Unit (ICU) of the National COVID-19 Reference Hospital. Patients were classified into moderate and severe clinical forms, based on the World Health Organization (WHO) definitions of clinical syndromes associated with COVID-19. CT scans were categorized as moderate (≤50%) or severe (>50%) grades, according to the extent of lung injuries. The chi-square test or Fisher's exact test, along with logistic regression, were conducted using R software.

Results: The study included 133 patients, with a mean age of 57.9±15.6 years and a sex ratio of 1.2. Comorbidities were present in 84.2% of patients, who presented with moderate (41.3%) and severe (58.7%) clinical forms. Lung lesions were categorized as moderate (45.1%) and severe (54.9%) grades. Clinical severity was associated with the extent of lung lesions on CT scans ($p<0.001$). Diabetes ($p=0.01$), low blood pressure ($p=0.04$), oxygen saturation levels below 85% ($SpO_2<85\%$; $p=0.04$), and respiratory distress ($p=0.02$) were associated with severe clinical forms. Obesity ($p=0.01$), $SpO_2<85\%$ ($p=0.04$), and respiratory distress ($p=0.02$) were associated with high-grade findings of CT scans.

Conclusions: Clinical severity in COVID-19 patients was associated with the severity of pulmonary CT scan findings. This clinical categorization could be useful in low-resource settings to guide the management of COVID-19 patients.

Keywords: Chest computed tomography scan; Clinical categorization; COVID-19; Intensive care; Respiratory distress.

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Introduction

Coronavirus Disease 2019 (COVID-19) is responsible for respiratory infections of varying severity, which can lead to severe pneumonia and acute respiratory failure.[1, 2] The severity of this respiratory impairment can be evaluated using clinical, biological, and chest imaging characteristics, with thin-slice chest Computed Tomography (CT) playing a crucial role. Clinical severity scores, such as the Acute Physiology and Chronic Health Evaluation (APACHE) and the Sequential Organ Failure Assessment (SOFA) are commonly utilized in assessing COVID-19 patients.[3, 4] Moreover, CT models are employed to ascertain the extent of lung involvement in chest CT scans through visual, semi-quantitative, and quantitative methods.[5-10] Assessing the severity of the disease is pivotal for guiding management strategies and predicting patient prognosis. Previous studies have demonstrated a correlation between severity scores, biological parameters like C-reactive protein and lactate dehydrogenase, and the extent of lung lesions observable on CT scans.[4, 8, 10, 11] However, in developing countries, healthcare facilities often lack the resources to utilize standard severity scores. Therefore, in our national COVID-19 reference center, disease severity was assessed based on clinical categorization, derived from the World Health Organization's (WHO) definition of clinical syndromes associated with COVID-19.[12] CT grading of lung involvement utilized a simplified visual evaluation, adhering to a five-stage classification reflecting the percentage of lung affected. Both clinical and simplified CT models could be useful, especially in low-resource settings. This study aimed to evaluate the relationship between clinical categorization and the severity scoring of chest CT scans in our environment, as well as to identify factors associated with disease severity.

Materials and Methods

Study Design

We conducted a descriptive and analytical retrospective study at Regional Hospital of Lomé Commune, the national reference center for COVID-19 patients. This study received authorization from the hospital's director following approval from the ethics committee. Patient consent was not required as only de-identified data were utilized. Data collection was conducted in accordance with the Helsinki Declaration.

Due to the absence of a CT scan unit at this hospital, an agreement with another facility, located 5 kilometers away, enabled CT scan examinations starting from the end of August 2020. The study period spanned the first two waves of COVID-19 recorded in our country, from January to April 2021 and from July to September 2021, respectively.[13] We included patients admitted to the Intensive Care Unit (ICU) between September 1, 2020, to September 30, 2021, diagnosed with COVID-19 and who had undergone chest CT imaging. Patients lacking essential data or who had died prior to undergoing medical examination were excluded.

Patient Selection

The clinical categorization of COVID-19 patients in our setting, derived from the WHO definition of clinical syndromes associated with COVID-19, was as follows:[12]

- **Mild form:** Patients with mild symptoms without signs of pneumonia or hypoxia.
- **Moderate form:** Patients presenting with pneumonia and moderate hypoxia, with oxygen saturation levels above 90% (SpO_2>90%), without signs of respiratory distress.
- **Severe form:** Patients presenting with signs of severe pneumonia, hypoxia with SpO_2<90%, and requiring oxygen flow greater than 10 liters per minute.
- **Critical form:** Patients with acute respiratory distress syndrome (ARDS), sepsis, shock, or other complications.

Patients in the critical and severe categories were admitted to the ICU. Additionally, patients with moderate conditions who required continuous monitoring and care due to the risk of rapid worsening were also admitted to the ICU, as there was no high-dependency unit available. Consequently, our study included patients with moderate, severe, and critical conditions.

Lung involvement was graded according to the model

recommended by the French Society of Thoracic Imaging (SIT).[5, 14] The SIT model advises a visual evaluation of lung involvement on chest CT scans based on the percentage of affected lung tissue. During the CT analysis, the radiologist assessed all slices of both lungs and estimated the percentage of parenchymal involvement (infected parenchyma). The lung involvement was then categorized as follows: minimal (≤10%), moderate (11 to 25%), extensive (26 to 50%), severe (51 to 75%) and critical (>75%).

For the purposes of our study, we grouped patients into two categories based on the clinical and CT scan severity.

Clinical Categorization

- Moderate forms
- **Severe forms:** included both severe and critical conditions

Operational Definitions

- **Dyspnea:** Discomfort and difficulty in breathing with a respiratory rate (RR) above 22 cycles per minute in adults.
- **Respiratory Distress:** Dyspnea accompanied by a RR above 22 cycles per minute, visible signs of respiratory struggle, and hypoxia. It is classified as moderate when RR is less than 30 cycles per minute and severe when RR is 30 cycles per minute or more.

Data Collection

Patients were assigned numeric codes for identification. Data were collected from medical records, CT scan reports, and the hospital's electronic database. CT images were analyzed and reviewed by a radiologist with 13 years of clinical experience.

The collected parameters included demographic characteristics; comorbidities; clinical parameters such as blood pressure, heart rate, respiratory rate, SpO_2, blood gasses (when available), Glasgow Coma Scale (GCS), evidence of vital distress, quick SOFA score, clinical form, chest CT features and extent, management strategies, and patient outcomes.

Data Analysis

Data were analyzed using R software, version 4.1.3 (R Core Team, the R Foundation, https://cran.r-project.org). Quantitative variables were presented as means with standard deviation (±SD) or medians with interquartile ranges (IQR), and qualitative variables were reported as frequencies (counts and percentages). The chi-square test of independence or Fisher's exact test was utilized to evaluate the relationship between CT scan findings and clinical severity. A p-value of less than 0.05 was considered statistically significant. Both univariate and multivariate logistic regression analyses were conducted to identify clinical and CT features associated with severity scores ($p<0.05$).

Results

Demographic and Epidemiological Characteristics

Out of the 2,069 patients admitted to the national COVID-19 reference center during the study period, 404 (19.5%) were in the ICU. Of the 304 ICU patients who required a chest CT, 298 underwent the examination. Among these, 75 patients were excluded: 11 had deceased before the examination, and 64 had missing data. Ultimately, 133 patients (32.9% of the ICU cohort) were included in our study. The mean age of these patients was 57.9±15.6 years (range: 19-92 years), and the sex ratio was 1.2. A total of 112 patients (84.2%) had at least one comorbidity, with hypertension, diabetes mellitus, and obesity being the most frequent (Table 1). Ten patients (7.5%) had been vaccinated against COVID-19.

Clinical Features

All patients presented with respiratory distress, including 124 cases (93.2%) with hypoxia. The respiratory distress was moderate in 89 patients (66.9%) and severe in 44 patients (33.1%). Eleven patients (8.3%) were in a coma with a GCS between 6 and 10, and 19 patients (14.3%) experienced low blood pressure, including nine patients (6.8%) in a septic shock condition. The quick SOFA (qSOFA) score was 1, 2, and 3 for 120 (90.2%), 12 (9.0%), and one patient (0.8%), respectively. According to clinical severity, 55 patients (41.3%) had a moderate form, and 78 patients (58.7%) had a severe form.

CT Scan Features

Ground-glass opacities (GGO) and crazy-paving pat-

Table 1. Clinical and chest CT scan characteristics of Covid-19 patients in intensive care unit

	Mean (±SD)[a] or Median (IR)[b]
Number (%)	
Age (years)[a]	57.9 (±15.6)
Sex/Male	73 (54.9)
Comorbidities	112 (84.2)
Diabetes Mellitus	61 (45.9)
Hypertension	68 (51.1)
HIV[c]	6 (4.5)
Asthma	9 (6.8)
Obesity	28 (21.1)
Others[d]	6 (4.5)
Cardiovascular and respiratory features	
Systolic blood pressure (mm Hg)[a]	140.8 (±18.7)
Diastolic blood pressure (mm Hg) [a]	82.4 (±12.5)
SpO_2 (%)[b]	86 (84-94)
CT scan features	
Typical features	
Ground-glass opacities	125 (94.0)
Crazy-paving[e]	95 (71.4)
Consolidation	9 (6.8)
Atypical features	
Pulmonary Hypertension	39 (29.3)
Atelectasis	29 (21.8)
Pulmonary embolism	14 (10.5)
Emphysema	3 (2.3)
Mediastinal lymphadenopathy	2 (1.5)

[a]Mean (±standard deviation), [b]Median (Interquartile Range), [c]HIV: Infection by Human Immunodeficiency Virus; [d]Others: Pulmonary embolism less than one month ago, Sickle cell disease, pulmonary tuberculosis, chronic obstructive pulmonary disease and chronic viral hepatitis B (one case respectively). [e]Ground-glass opacities with consolidation or visible interlobular line

terns, characterized by GGO with superimposed interlobular septal thickening and interlobular reticulations, were the most common CT findings in 125 (94.0%) and 95 (71.4%) cases, respectively (Table 1). Lung lesions were classified as moderate grade in 60 patients (45.1%) and severe grade in 73 patients (54.9%).

Treatment and Outcome

In 112 cases (84.2%), patients were treated with standard oxygen therapy alone. In 21 cases (15.8%), patients received combined oxygen therapy and mechanical ventilation, which included non-invasive ventilation (NIV) in 19 cases (14.3%) and invasive ventilation (IV) in four cases (3.0%). Arterial blood gas analysis was performed on eight patients, revealing severe ARDS (partial pressure of oxygen to fractional inspired oxygen ratio, PaO_2/FiO_2<100 mm Hg) in seven patients and moderate ARDS (PaO_2/FiO_2=100 to 200 mm Hg) in one patient.

Table 2. Relationship between CT scan and clinical severity in Covid-19 patients admitted to intensive care unit

	CT scan severity grade			
	Moderate n=60	Severe n=73	Total n=133	p[a]
Clinical severity				<0.001
Moderate	35 (58.3)	20 (27.4)	55 (41.4)	
Severe	25 (41.7)	53 (72.6)	78 (58.6)	

[a]P-value for chi-square test or Fisher's exact test.

The median duration of ICU stay was 14 days (IQR: 9-20 days), with a range from three to 48 days. One hundred and ten patients (82.7%) were successfully transferred to the general ward, while 23 patients (17.3%) died in the ICU.

Relationship Between Clinical and CT Scan Severity and Their Associated Factors

Clinical severity was associated with the extent of pulmonary involvement as assessed by CT scan grading (Table 2). Bivariate analysis revealed that a history of diabetes and hypertension, SpO_2, blood pressure, respiratory distress, and the presence of ground-glass and crazy-paving patterns were associated with clinical severity (Table 3). Obesity, SpO_2 levels, respiratory distress, and crazy-paving patterns were associated with CT grading (Table 4). Univariate and multivariate logistic regression analyses identified diabetes (p=0.01), low blood pressure (p=0.04), respiratory distress (p=0.02), and hypoxia with SpO_2<85% (p=0.04) as having a significant independent association with severe clinical presentations (Table 5).

In terms of CT scan severity, univariate and multivariate logistic regression analyses found obesity (p=0.01), hypoxia with SpO_2<85% (p=0.04), and respiratory distress (p=0.02) as independent factors associated with a severe grade (Table 6).

Table 3. Factors associated with the clinical severity of Covid-19 in intensive care patients

	Total n=133	Clinical severity n (%)		p[a]
		Moderate n=55	Severe n=78	
Age groups				0.40
[19-60 years]	72 (54.1)	32 (58.2)	40 (51.3)	
≥60 years	61 (45.9)	23 (41.8)	38 (48.7)	
Sex/ Male	73 (54.9)	33 (60.0)	40 (51.3)	0.30
Diabetes mellitus	61 (45.9)	15 (27.3)	46 (59.0)	<0.001
Hypertension	68 (51.1)	18 (32.7)	50 (64.1)	<0.001
Obesity	28 (21.0)	9 (16.4)	19 (24.4)	0.30
SpO_2 (%)				0.01
[95-99]	28 (21.0)	18 (32.7)	10 (12.8)	
[35-75]	15 (11.3)	4 (7.3)	11 (14.1)	
[75-85]	25 (18.8)	5 (9.1)	20 (25.6)	
[85-95]	65 (48.9)	28 (50.9)	37 (47.4)	
Blood pressure				0.08
Normal	101 (75.9)	47 (85.4)	54 (69.2)	
Hypotension	19 (14.3)	4 (7.3)	15 (19.2)	
Hypertension	13 (9.8)	4 (7.3)	9 (11.5)	
Respiratory distress				<0.001
Moderate	89 (66.9)	47 (85.4)	42 (53.8)	
Severe	44 (33.1)	8 (14.5)	36 (46.1)	
Coma	11 (8.3)	3 (5.4)	8 (10.3)	0.50
Ground-glass opacities	125 (94.0)	49 (89.1)	76 (97.4)	0.06
Crazy-paving[b]	95 (71.4)	33 (60.0)	62 (79.5)	0.01
Consolidation	9 (6.8)	3 (5.4)	6 (7.7)	0.70

[a]P-value for chi-square test or Fisher's exact test; [b]Ground-glass opacities with consolidation or visible interlobular lines.

Table 4. Factors associated with CT scan severity in Covid-19 patients admitted to intensive care unit

	Total n=133	CT scan severity grade, n (%)		p[a]
		Moderate n=60	Severe n=73	
Age groups				0.2
[19-60 years]	72 (54.1)	29 (48.3)	43 (58.9)	
≥60 years	61 (45.9)	31 (51.7)	30 (41.1)	
Sex/ Male	73 (54.9)	32 (53.3)	41 (56.2)	0.7
Diabetes mellitus	61 (45.9)	25 (41.7)	36 (49.3)	0.4
Hypertension	68 (51.1) 29	(48.3)	39 (53.4)	0.6
Obesity	28 (21.05)	7 (11.7)	21 (28.8)	0.02
SpO_2 (%)				0.002
[95-99]	28 (21.05)	19 (31.7)	9 (12.3)	
[35-75]	15 (11.3)	2 (3.3)	13 (17.8)	
[75-85]	25 (18.8)	7 (11.7)	18 (24.7)	
[85-95]	65 (48.9)	32 (53.3)	33 (45.2)	
Blood pressure				0.8
Normal	101 (75.9)	44 (73.3)	57 (78.1)	
Hypotension	19 (14.3)	9 (15.0)	10 (13.7)	
Hypertension	13 (9.8)	7 (11.7)	6 (8.2)	
Respiratory distress				<0.001
Moderate	89 (66.9)	50 (83.3)	39 (53.4)	
Severe	44 (33.1)	10 (16.7)	34 (46.6)	
Coma	11 (8,3)	7 (11,7)	4 (5,5)	0.2
Ground-glass opacities	125 (94.0)	54 (90.0)	71 (97.3)	0.14
Crazy-paving[b]	95 (71.4)	37 (61.7)	58 (79.4)	0.02
Consolidation	9 (6.8)	2 (3.3)	7 (9.6)	0.2

[a]P-value for chi-square test or Fisher's exact test; [b]Ground-glass opacities with consolidation or visible interlobular lines

Discussion

This was a single-center study conducted in a COVID-19 dedicated ICU. The majority of patients admitted to the ICU had comorbidities, consistent with previous research in similar settings and developed countries.[15-19] Hypertension, diabetes, and obesity were the most common comorbidities observed in our study, aligning with findings from other research.[15-19] These conditions are known to exacerbate the severity of COVID-19 by chronically impairing vital functions.

A significant proportion (41.3%) of patients in our study had moderate forms of the disease. This can be attributed to the fact that our ICU admitted patients who would normally require high-dependency care. Additionally, critically ill patients who could not be transported to the CT facility were excluded from the study, reflecting the low frequency of conducted CT scans. The CT scans performed predominantly showed severe lung involvement, with ground-glass opacities (GGO) and crazy-paving patterns being common findings, consistent with previous reports on CT imaging in COVID-19 patients.[20-23]

Conventional severity scores such as APACHE or

Table 5. Univariate and multivariate logistic analysis of factors associated with the clinical severity of Covid-19 in intensive care.

	Univariate analysis			Multivariate analysis		
	OR[a]	95% IC[b]	p[c]	OR[d] 95%	IC[b]	p[c]
Age ≥60 years	1.3	0.6-2.8	0,4	0.8	0.3-2.1	0,7
Sex/female	0,7	0,3-1,4	0.3	1.2	0.5-2.9	0.8
Diabetes mellitus	3.83	1.8-8.3	<0.001	3.6	1.4-9.7	0.01
Hypertensione	3.67	1.8-7.7	<0.001	2.4	1.9-6.8	0.04
SpO^2 (%)			0.01			0.02
[95-99]	—	—		—	—	
[35-75]	4.95	1.32-8.90	0.02	1.90	1.15-5.58	0.02
[75-85]	5.20	2.19-8.40	0.002	1.99	1.16-6.13	0.01
[85-95]	2.38	1.97-11.12	0.04	0.93	0.29-4.96	0.08
Blood pressure			0.07			0.04
Normal	—	—		—	—	
Hypotension	3.26	1.10-12.10	0.05	5.53	1.41-27.10	0.02
Hypertension	1.96	0.60-7.61	0.29	2.15	0.47-12.30	0.34
Respiratory distress			<0.001			0.02
Moderate	—	—		—	—	
Severe	5.04	2.19-12.80	<0.001	4.47	1.25-18.30	0.03
Crazy-paving[f]	2.58	1.20-5.66	0.02	2.58	0.87-8.12	0.09
Ground-glass opacities	4.65	1.03-32.60	0.07	2.61	0.35-28.0	0.38

[a]OR: Odds Ratio; [b]95% IC: 95% confidence interval; [c]P-value for chi-square test or Fisher's exact test; [d]OR: adjusted Odds Ratio; [e]History of hypertension; [f]Groundglass opacities with consolidation or visible interlobular lines.

SOFA were not utilized in our study due to the limited availability of laboratory tests. Blood gasses and some laboratory tests were not always accessible. The quick SOFA score was used for the initial assessment, directing patients to either the general ward or the ICU based on their score. Although visual evaluation of CT severity is a straightforward and rapid method, it is less accurate and reproducible compared to semi-quantitative and quantitative methods. Nevertheless, the radiologist responsible for analyzing the CT images in our study had extensive clinical experience. Semi-quantitative methods involve assessing the percentage of lung involvement in each lobe or region, with the overall CT score being the sum of scores from all affected lung lobes or regions.[6, 7, 10, 24] Quantitative scoring often utilizes algorithms provided by artificial intelligence.[9]

We found that the clinical severity of the disease was associated with the extent of lung lesions observed on CT scans. Patients with more severe conditions exhibited a greater extent of lung involvement, consistent with previous literature that utilized clinical categorization and a semi-quantitative CT method. Li K et al.[8] demonstrated that CT scores of severe and critical COVID-19 patients were significantly higher than those of ordinary patients.[10] The association between clinical and CT severity has been extensively studied, employing both initial and progressive CT scan images.[7, 25, 26]

Furthermore, we identified factors associated with severity scores. The presence of diabetes, hypertension, obesity, existing cardiovascular failure, and respiratory distress were all linked to severe clinical forms. These findings align with data reported in other studies.[4, 17, 22] Beyond the extent of lung involvement, the pattern of lung injury was a determining factor for severity in the literature. Crazy-paving and GGO features were associated with severe clinical forms of COVID-19 and high SOFA scores.[8] Additionally, Hejazi ME et al.[4] reported significant relationships between the SOFA score at admission and multifocal and bilateral GGOs. However, these aspects were not specifically addressed in our study.

Table 6. Univariate and multivariate logistic analysis of factors associated with CT scan severity In Covid-19 patients admitted to intensive care unit

	Univariate analysis			Multivariate analysis		
	OR[a]	95% IC[b]	p[c]	OR[d]	95% IC[b]	p[c]
Age ≥60 years	0.65	0.33 – 1.30	0.22	0.49	0.20 – 1.13	0.10
Sex/female	1.12	0.56 – 2.23	0.74	2.03	0.87 – 5.01	0.11
Obesity	3.06	1.25 – 8.32	0.02	4.11	1.43 – 13.30	0.01
SpO_2 (%)			<0.001			0.04
[95-99]	—	—		—	—	
[35-75]	7.70	3.00 – 11.16	0.002	3.50	2.59 – 17.0	0.02
[75-85]	5.43	1.73 – 10.70	0.005	1.35	1.25 – 6.96	0.02
[85-95]	2.18	0.88 – 5.72	0.10	1.15	0.93 – 7.40	0.80
Respiratory distress			<0.001			0.02
Moderate	—	—		—	—	
Severe	4.36	1.98 – 10.30	<0.001	3.91	1.18 – 14.50	0.03
Coma	0.44	0.11 – 1.53	0.21	0.70	0.15 – 2.87	0.63
Crazy-pavinge	2.40	1.12 – 5.28	0.03	1.99	0.73 – 5.64	0.18
Ground-glass opacities	3.94	0.87 – 27.60	0.10	1.11	0.18 – 9.37	0.92
Consolidation	3.08	0.71 – 21.20	0.17	2.54	0.52 – 19.10	0.29

[a]OR: Odds Ratio; [b]95% IC: 95% confidence interval; [c]P-value for chi-square test or Fisher's exact test; [d]OR: adjusted Odds Ratio; [e]Ground-glass opacities with consolidation or visible interlobular lines.

Patients were managed with standard oxygen therapy in most cases. The reported mortality rate was lower compared to other studies conducted under similar resource conditions, where mortality rates ranged from 25% to 41.7%.[16, 27, 28] This discrepancy could be attributed to the exclusion of critically ill patients who did not undergo CT scans.

There are certain limitations to our study. Firstly, an inclusion bias existed, as not all critically ill patients admitted to the ICU during the study period were included. Additionally, the absence of follow-up CT scans prevented the assessment of the relationship between clinical and CT severity as the patients' conditions progressed. Furthermore, the unavailability of blood gas analyses for assessing clinical severity limited the comprehensive evaluation of severity.

Nevertheless, the association between clinical and CT severity observed in this study underscores the utility of the clinical categorization used in our setting. This categorization could prove valuable in COVID-19 hospitals where laboratory and imaging examinations are limited or challenging to perform.

Conclusion

Patients admitted to the intensive care unit at the national COVID-19 reference hospital exhibited moderate and severe clinical forms. The lung involvement observed on CT scans was heterogeneous, with ground-glass opacities and crazy-paving patterns being the most common findings. The clinical severity of the disease was correlated with the extent of lung involvement. The availability of CT scans at the COVID-19 hospital near the ICU, along with access to laboratory tests, would improve the assessment and care of patients. Further studies involving large cohorts and the use of standardized severity scores may enhance the methods of severity assessment employed in this study.

Ethics Committee Approval: The study was authorized by Regional Hospital of Lomé Communne director after the ethics committee has checked protocol. As patients were not involved, it did not require an approval from the national ethics committee (Authorization number: 230/2021/MSHPAUS/CAB/SG/D-CHR-LC, Date: 29.10.2021).

Informed Consent: This study was retrospective and did not

involve the patients themselves. Thus, their consent was not required.

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References

1. Wu Z, McGoogan JM. Characteristics of and Important Lessons From the Coronavirus Disease 2019 (COVID-19) Outbreak in China: Summary of a Report of 72 314 Cases From the Chinese Center for Disease Control and Prevention. JAMA. 2020;323(13):1239—42.[CrossRef]
2. Guan WJ, Ni ZY, Hu Y, et al.; China Medical Treatment Expert Group for Covid-19. Clinical Characteristics of Coronavirus Disease 2019 in China. N Engl J Med. 2020;382(18):1708—20. [CrossRef]
3. Ayvat P, Kayhan Omeroglu S. Mortality estimation using APACHE and CT scores with stepwise linear regression method in COVID-19 intensive care unit: A retrospective study. Clin Imaging. 2022;88:4—8. [CrossRef]
4. Hejazi ME, Malek Mahdavi A, Navarbaf Z, et al. Relationship between chest CT scan findings with SOFA score, CRP, comorbidity, and mortality in ICU patients with COVID-19. Int J Clin Pract. 2021;75(12):e14869. [CrossRef]
5. Covid-19 pandemic: The fundamental diagnostic role of imaging. Journal D'Imagerie Diagnostique et Interventionnelle. 2020;3(4):230. French. [CrossRef]
6. Chung M, Bernheim A, Mei X, et al. CT Imaging Features of 2019 Novel Coronavirus (2019-nCoV). Radiology. 2020;295(1):202—7.
7. Yang R, Li X, Liu H, et al. Chest CT Severity Score: An Imaging Tool for Assessing Severe COVID-19. Radiol Cardiothorac Imaging. 2020;2(2):e200047. [CrossRef]
8. Li K, Wu J, Wu F, Guo D, Chen L, Fang Z, Li C. The Clinical and Chest CT Features Associated With Severe and Critical COVID-19 Pneumonia. Invest Radiol. 2020;55(6):327—31. [CrossRef]
9. Bai HX, Wang R, Xiong Z, et al. Artificial Intelligence Augmentation of Radiologist Performance in Distinguishing COVID-19 from Pneumonia of Other Origin at Chest CT. Radiology. 2020;296(3):E156—65. Erratum in: Radiology. 2021;299(1):E225. [CrossRef]
10. Li K, Fang Y, Li W, et al. CT image visual quantitative evaluation and clinical classification of coronavirus disease (COVID-19). Eur Radiol. 2020;30(8):4407—16. [CrossRef]
11. Xiong Y, Sun D, Liu Y, et al. Clinical and High-Resolution CT Features of the COVID-19 Infection: Comparison of the Initial and Follow-up Changes. Invest Radiol. 2020;55(6):332—9. [CrossRef]
12. World Health Organization. Clinical management of severe acute respiratory infection (SARI) when COVID-19 disease is suspected: interim guidance, 13 March 2020. https://iris.who.int/handle/10665/331446 (Accessed on February 24, 2023).
13. World Health Organization. Togo country overview of coronavirus disease (COVID-19) by date. https://www.who.int/countries/tgo (Accessed on March 5, 2023).
14. Lodé B, Jalaber C, Orcel T, et al. Imaging of COVID-19 pneumonia. Journal D'Imagerie Diagnostique et Interventionnelle. 2020;3(4):249—58. French. [CrossRef]
15. Mouzou ET, Assenouwe S, Sama HD, et al. Oxygen Therapy and Ventilation for the Management of Patients with Covid-19 in Intensive Care. London Journal of Medical and Health Research. 2022;22(11):1—10.
16. Donamou J, Bangoura A, Camara LM, et al. Epidemiological and clinical characteristics of COVID-19 patients admitted to the intensive care unit of Donka hospital in Conakry, Guinea: Descriptive study of the first 140 hospitalised cases. Anesthésie & Réanimation. 2021;7(2):102–9. French. [CrossRef]
17. Bennett S, Tafuro J, Mayer J, et al. Clinical features and outcomes of adults with coronavirus disease 2019: A systematic review and pooled analysis of the literature. Int J Clin Pract. 2021;75(3):e13725. [CrossRef]
18. Mitra AR, Fergusson NA, Lloyd-Smith E, et al. Baseline characteristics and outcomes of patients with COVID-19 admitted to intensive care units in Vancouver, Canada: a case series. CMAJ. 2020;192(26):E694—701. [CrossRef]
19. Bhatraju PK, Ghassemieh BJ, Nichols M, et al. Covid-19 in Critically Ill Patients in the Seattle Region - Case Series. N Engl J Med. 2020;382(21):2012—22. [CrossRef]
20. Simpson S, Kay FU, Abbara S, et al. Radiological Society of North America Expert Consensus Statement on Reporting Chest CT Findings Related to COVID-19. Endorsed by the Society of Thoracic Radiology, the American College of Radiology, and RSNA - Secondary Publication. J Thorac Imaging. 2020;35(4):219—27. [CrossRef]
21. Mahsouli A, Grillo M, Amini N, et al. Imagerie thoracique du COVID-19. Louvain Med. 2020;139(05-06):360—7.
22. Ai T, Yang Z, Hou H, Zhan C, et al. Correlation of Chest CT and RT-PCR Testing for Coronavirus Disease 2019 (COVID-19) in China: A Report of 1014 Cases. Radiology. 2020;296(2):E32—40. [CrossRef]
23. Salehi S, Abedi A, Balakrishnan S, et al. Coronavirus disease 2019 (COVID-19) imaging reporting and data system (COVID-RADS) and common lexicon: a proposal based on the imaging data of 37 studies. Eur Radiol. 2020;30(9):4930—42. [CrossRef]
24. Hajiahmadi S, Shayganfar A, Janghorbani M, et al. Chest Computed

Tomography Severity Score to Predict Adverse Outcomes of Patients with COVID-19. Infect Chemother. 2021;53(2):308—18. [CrossRef]

25. Francone M, Iafrate F, Masci GM, et al. Chest CT score in COVID-19 patients: correlation with disease severity and short-term prognosis. Eur Radiol. 2020;30(12):6808—17. [CrossRef]
26. Khosravi B, Aghaghazvini L, Sorouri M, et al. Predictive value of initial CT scan for various adverse outcomes in patients with COVID-19 pneumonia. Heart Lung. 2021;50(1):13—20. [CrossRef]
27. Ahounou E, Glèlè Aho LRG, Akodjenou J, et al. Evaluation de la Prise en Charge des Cas Graves de Covid-19 aux soins Intensifs dans Un Environnement a Ressources Limitées : Expérience du Centre de Traitement des Épidémies (CTE) d'Allada. Journal de la Société de Biologie Clinique du Bénin. 2021;038:107—12.
28. Arnold-Day C, Van Zyl-Smit RN, Joubert IA, et al. Outcomes of patients with COVID-19 acute respiratory distress syndrome requiring invasive mechanical ventilation admitted to an intensive care unit in South Africa. S Afr Med J. 2022;112(1):13516. [CrossRef]