Clinical analysis of 207 patients with coronavirus disease 2019 (COVID-19) in Shanghai, China

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1 **Clinical analysis of 207 patients with coronavirus disease 2019 (COVID-19) in**
2 **Shanghai, China**

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Abstract

Objectives: To investigate clinical features and the chest computed tomography (CT) findings in patients with confirmed cases of coronavirus disease 2019 (COVID-19) in Shanghai.

Materials and Methods: Two hundred seven patients (102 men and 105 women, 15-84 years old) with COVID-19 from 23 January 2020 to 8 February 2020 were retrospectively reviewed. The imaging findings, clinical and laboratory data of the patients were evaluated and analyzed. The CT score was determined by totaling the lobes of lungs affected ranging from 0-25.

Results: The median time from onset of symptoms to first hospital admission was 5.3 ± 3.9 days. After being tested positive, the hospital stay of patients with onset of symptoms within one week is longer than that of patients with onset of symptoms over one week (15.7 vs. 11.5 respectively, $p < 0.01$). The initial lung findings of patients with COVID-19 on chest CT were small subpleural ground glass opacities (GGO) that grew larger with crazy-paving pattern and consolidation with or without interstitial opacity. The mean CT scores peaked at 8-10 days of illness, with a slow decline thereafter and substantial scores after the 10 days. Both age and CD4+ cell counts had a remarkable prognostic effect on imaging outcomes ($p < 0.05$).

Conclusion: For patients in mild-to-moderate condition, the disease began to improve after 10 days from the initiation of the symptoms. Both age and baseline CD4+ cell count were pivotal predictor of the outcome of imaging of the patients with COVID-19.

Keywords: coronavirus disease 2019 (COVID-19), severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), HRCT score.

Introduction

Coronavirus disease 2019 (COVID-19) is an infectious disease that was identified in December 2019. The disease was first reported among people in Wuhan, Hubei province, China. Since then it has been spreading all over the world. The rapid outbreak of novel coronavirus 2019 (COVID-19) has become a matter of international concern as the disease is spreading fast with a fascinating speed making it a global emergency [1-5].

The common chest radiographic manifestations of COVID-19 are GGO lesions initially which further progressed into consolidation and interstitial opacity. According to the early reports from Wuhan, lung abnormalities on chest CT showed the greatest severity approximately 10 days after the initial onset of symptoms [6-7].

Shanghai Public Health Clinical Center is the designated hospital for diagnosis and management of infectious diseases and threats against public health in China [8] which is also assigned as the training organization for new emerging infectious diseases by WHO. At the time of this writing, 207 confirmed patients with COVID-19 infection were admitted to the center.

Materials and Methods

Patients

Two hundred seven patients (102 men and 105 women, 15-84 years old) with COVID-19 confirmed positive by new coronavirus nucleic acid antibody underwent from 23 January 2020 to 8 February 2020 admitted to our center were retrospectively reviewed. The patients without CT imaging were excluded. Shanghai Public Health Center Ethics Committee has approved this study. (Petition no: YJ-2020-S035-01)

The chest imaging findings, clinical and laboratory data of the patients were evaluated. Laboratory confirmation was performed by sputum and throat swab testing positive for the specimens collected from all patients at the time of hospital admission using real-time reverse transcription-polymerase chain reaction for COVID-19 RNA. They also underwent blood testing that included a complete blood count (CBC), serum biochemistry, and identification of other potential respiratory pathogens.

In this study, the patients were divided into 4 different groups according to the days after the onset of symptoms from the day of hospital admission as group 1 (0-3 days), group 2 (4-7 days), group 3 (8-10 days) and group 4 (>10 days).

CT Imaging and Scoring

All the patients underwent their first chest CT scan at the time of admission to the hospital. These chest CT examinations were performed with a 64-section scanner (SCENARIA 64 CT, Hitachi Medical, Japan) without contrast material. The CT protocol was as follows: 120 kV; automatic tube current (180 mA-400 mA); iterative reconstruction technique; detector, 64 mm; rotation time, 0.35 second; section thickness, 5 mm; collimation, 0.625 mm; pitch, 1.5; matrix, 512*512; and breath hold at full inspiration. The following windows were used: a mediastinal window with a

window width of 350 HU and a window level of 40 HU, and a long window with a width of 1200 HU and a level of -600 HU.

A semi-quantitative scoring system was used to quantify the extent of disease. A thin-section CT score as shown in Table 1, was used to quantitatively estimate the pulmonary involvement. Each of the 5 lung lobes was visually scored from chest CT scan, with a total possible score of 0-25, where 0 symbolized no involvement in increasing order to 25 which symbolized maximum involvement for each of the three findings scored at each chest CT examination. This scoring system has been used to evaluate pulmonary lesions in previous studies (9,10).

For the 162 patients who had altogether 4 consecutive regular follow-up chest CT scan, the imaging outcome of each patient was determined based on CT scoring (Figure 1).

Statistical analysis

All the data were statistically analyzed using Stata software package version 10.0 (Stata Corp LP, College Station, Texas, USA). Data were expressed as mean $\pm$ standard deviation (SD), or median for the continuous variables. The comparison of discrete variables between groups was performed using Pearson 2 test. Correlation analysis was performed using factor analysis method and COX model regression. All analyses were considered significant at p values less than 0.05.

Results

Personal and clinical characteristics

Out of the 207 patients (105 female and 102 male), 76 (36.7%) of the patients were aged 19-40 years, 91(44.0%) were aged 41-65 years, 2 (1%) were aged under 18 years, and 36 (18.4%) were aged 65 years and older (Figure 2). 198(95.7%) of patients had a history of traveling or residing in Wuhan or may had possible exposure to patients with fever and respiratory symptoms within 2 weeks before manifesting the illness from Wuhan. (Table 2). Eighty-nine of the 207 patients (43.0%) had underlying diseases such as hypertension in 50 (24.2%), diabetes mellitus in 15(7.2%), chronic obstructive pulmonary disease (COPD) in 3 (1.4%), chronic liver disease in 5 (2.4%) and 3 (1.4%) had renal disease.

The most common symptoms of illness onset were fever (188, 90.8%), cough (81, 38.2%), expectoration (43, 20.3%), dizziness and headache (23, 10.8%), muscle ache (57, 26.9 %) patients. The vast majority of patients had no deranging values for absolute white blood cell count (204, 98.6%) of patients. The percentage of neutrophils was abnormal in 39 patients among which 34 (16.4%) had increased, and 5 (2.4%) had decreased values. Meanwhile, the absolute lymphocyte cell count decreased in 103 (49.8%) of patients whereas it was increased in only 2 (1.0%) of patients. The proportion of lymphocytes was seen to decrease in 65 (31.4%) and increased in 5 (2.4%) patients (Table 3).116 (56.0%) of the patients were found to have elevated C-reactive protein (CRP), erythrocyte sedimentation rate (ESR) was increased in 177 (85.5%) of patients and 128 (61.8%) of patients had elevated haptoglobin (Hp). None of the patients were encountered to have an increase of procalcitonin (PCT). Similarly, further examinations revealed fibrinogen was elevated in 131 (63.3%) patients, 93 (44.9%) patients had elevated D-dimmer, 84 (40.6%) patients had increased lactate dehydrogenase (LDH) and 84 (40.6%) patients with

elevated Glutathione reductase. 63 (30.4%) patients had positive urine protein among which 8 patients were tested strongly positive ($\geq 3+$).

Pulmonary CT initial Evaluation

Data on initial chest CT findings in 207 patients with COVID-19 pneumonia are presented in Tables 4 and 5. The major manifestations on CT observed were GGO (202/207 cases, 97.6%), consolidation (127/207 cases, 61.4%) and interlobular septal thickening (49/207, 23.7%) (Table 4). Besides that, 136/207 (65.7%) of patients had mixed patterns among which 90(43.5%) had both GGO and consolidation, 9 (4.3%) had both GGO and interlobular septal thickening, 37(17.9%) had GGO, consolidation and interlobular septal thickening. The average scores from the initial evaluation of 207 patients are shown in Table 4 and Figure 4. Increased CT score was observed since day 4 of illness, and the median CT score was increased from 5.7 ± 4.6 to 8.1 ± 4.5 . After 10 days of illness, the score decreased slowly to a median score 8, and this decrease reflected the presence of residual disease (Figure 3A). Both the GGO and consolidation showed the same trend, while the interstitial change score was seen to gradually rise from day 0-10 of illness.

The characteristic chest imaging presentation was “crazy paving sign” which was seen in 114 (55.1%) patients (Figure 4C). Similarly, 33(15.9%) of patients had nodules, 25 (12.1%) of patients had halo sign or anti-halo sign, 6 (2.9%) of patients had lymph node enlargement, 3 (1.4%) of patients had pleural effusion and 7 (3.4%) of patients had pericardial effusion. 149 patients had more than 5 lung segments involvement on chest CT (Table 5). 168 (81.2%) patients showed bilateral involvement, and 39 (18.8%) patients showed unilateral involvement. The lung lesions in 190 (91.8%) patients showed a multifocal distribution, and in 17 (8.2%) showed a focal distribution. There were 160 (77.3%) patients with lung lesions distributed in the lung periphery. Random distribution of lung lesions was seen in 25 (12.1%) patients and 21 (10.1%) patients had diffuse lung lesions distribution. Only 1

183 patient had a central distribution of lung lesions due to the presence of significant
184 secondary bacterial infections. Typical chest CT findings of infected patients on
185 admission were bilateral, multiple lobular, sub-segmental areas of pulmonary
186 consolidation or bilateral GGO (Figure 5, Figure 6).

187 188 **Clinical and biochemical indicators related to imaging outcomes**

189 In this study 162 patients had 4 consecutive regular follow-up chest CT scan
190 altogether. Based on the CT score, the imaging outcome of each patient was
191 determined. For defining an improvement in the event, Cox regression analysis was
192 used to study the correlation between imaging outcomes in COVID-19 and
193 biochemical indicators. The results showed that age and CD4+ cell counts had the
194 most prognostic effect on imaging outcomes ($P < 0.05$). With increasing CD4+ cell
195 counts, pneumonia tends to improve including GGO, consolidation and interstitial
196 lung disease (ILD) (Table 6). With a higher LDH level, GGO was observed to be
197 more difficult to be restored.

198 199 **Baseline CD4+ cell count and imaging outcomes**

200 Receiver operating characteristic curve (ROC) was used to evaluate the cutoff value
201 of CD4+ cell count as a predicting factor for the prognosis of overall imaging
202 outcomes. A cut-off value of 247 was obtained from ROC curve, and this cut-off
203 value yielded a sensitivity of 85% and a specificity of 40% (Figure 7). The area under
204 the curve (AUC) value of the ROC was 0.568.

Discussion

Compared to SARS in 2003, COVID-19 is accounted to spread faster and farther. When compared with patients initially infected with COVID-19 in Wu Han [9-10], the symptoms of patients in Shanghai were relatively mild. In the past four weeks, most of the cases were mainly foreign imported cases in Shanghai. Whether there is any difference between the newly added imported cases and the current cohort in this study requires further research and discussion.

In our study, the initial lung findings of patients of COVID-19 on chest CT were small subpleural GGO that grew larger with crazy-paving pattern and consolidation with or without interstitial opacity. The CT scores peaked in group 3 means 8-10 Days of illness (Figure 4A), with a slow decline thereafter and substantial scores after the 10 days. This change in the period was shorter than SARS in 2003, according to Ooi and collages' report. The CT scores of SARS peaked at 2nd week of illness, with a slow decline thereafter and substantial scores after the 4th week [11]. Besides, the same trend was showed in various biochemical indicators including blood routine, CRP, ESR, Hp and LDH as shown in Table 3. Interestingly, the hospital stay of patients more than 7 days (group3 and 4) is shorter than that of the patients who manifested in 0-7 days (group1 and 2) and the difference was statistically significant ($p<0.01$). The above results suggest that for mild patients, the disease begins to improve after 10 days of symptoms.

While regarding the consecutive CT scans serially obtained in our cohort provided an opportunity to study the correlation between imaging outcomes in COVID-19 and biochemical indicators. For 162 patients who had altogether 4 consecutive regular follow-up chest CT scans, Cox regression analysis showed that age and CD4+ cell counts had the most prognostic effect on imaging outcomes ($p<0.05$). With increasing age, pneumonia becomes less likely to be absorbed putting a strong impact on overall improvement and healing of interstitial opacity of the patients. With increasing CD4+

cell counts, presentations of pneumonia tend to improve improving conditions such as GGO, consolidation, and ILD. (Table 6). After two weeks, the lesions were gradually absorbed leaving an extensive GGO and subpleural parenchymal bands. On the contrary, a higher LDH was found to have an inverse relation with the recovery of GGO. Maximum levels of LDH have been reported to increase the mortality rate in H1N1-associated pneumonia.

A study of age and viral pneumonia also demonstrated other concomitant respiratory viral infections occurring at different frequencies in different age groups. It demonstrated respiratory viruses (RVs) were found in 262 patients (27.5%) such as influenza virus A (IFV A, 9.9%) which comprised of pandemic H1N1 (6.7%) and seasonal H3N2 (3.5%), human rhinovirus (4.3%), adenovirus (4.2%), human metapneumovirus (1.8%), parainfluenza virus 1, 3 and 2 (1.7%, 1.5% and 1.2% respectively). Influenza virus B, enterovirus, respiratory syncytial virus, other strains of human coronavirus (MERS-CoV, SARS-CoV) and parainfluenza virus 4 were rarely detected (<1%). The frequency of IFV A was highest among patients aged between 45–64 years ($p < 0.001$), while adenovirus among patients aged 14–17 years ($p < 0.001$). No differences were found in other RVs [12]. In our study, 91 (44%) were aged 41–65 years, 76 (37%) of the patients were aged 19–40 years, 2 (1%) were aged 15 and 16 years, and 38 (17%) were aged 65 years and older. Elderly patients had a higher incidence of severe illness. This study reflects how age is relevant to imaging outcomes, especially interstitial changes. Older the patient is, lower is the possibility for the healing of the fiber strands in the lung. A similar phenomenon was also observed in SARS in 2003. Antonio GE reported that pulmonary fibrosis may develop early in patients with SARS who have been discharged after treatment. Patients who are older and have more severe disease during treatment are more likely to develop thin-section CT findings of fibrosis [13].

The process of aging is characterized by progressive functional impairment and reduced capacity to respond appropriately to environmental stimuli and injury. Although the incidence and severity of fibrotic diseases increase with increasing age, there has been relatively little investigation into the mechanisms of the effects of aging on susceptibility to these disorders. Normal aging mechanisms include cumulative DNA mutations, oxidative and cell stresses, mitochondria dysfunction, increased susceptibility to apoptosis, telomere length dysfunction and differential gene expression as a consequence of epigenetic changes and miRNA regulation. These natural aging processes cause dysfunction and impaired repairing capacity of lung epithelial cells, fibroblasts and MSCs. As a consequence, the composition of the extracellular matrix changes and the dynamic interaction between cells and their environment is damaged. A better understanding of these aging biological processes and repair responses may provide novel and better therapeutic approaches for such devastating diseases [14]. In this study, most patients were mild-to-moderate cases with most of them showing the absorption of interstitial changes and the remaining fibrosis was not obvious as Figure 6 showed. The proportion of fibrosis that occurs in severe or critically ill patients is worthy of further research.

In this study, we found that the baseline CD4 cell count is an important factor affecting the prognosis. Meantime, low CD4 showed positively correlated with interstitial changes like it was also found in SARS 2003 [15]. We already know that CD4+ T cells play important roles in the development of lung fibrosis. And the discovery of several subsets of CD4(+) Th lymphocytes has contributed to refine and to challenge our understanding roles of CD4(+) T cells in the pathogenesis of fibrotic lung diseases. Previous studies had shown that CD4(+) T subpopulations possess contrasting pro- and antifibrotic activities in human and experimental lung fibrosis. Special attention was given to delineate the activity of the newly discovered CD4(+) T lymphocyte subsets (Tregs, Th22, and Th9) on fibroblast function and matrix deposition through the release of growth factors, cytokines, and eicosanoids. It

appears that the function of a CD4(+) T lymphocyte subset or cytokine can differ with the disease stage (acute vs. chronic), pulmonary localization (bronchial vs. alveolar), cellular level (epithelial cell vs. fibroblast), or immune environment (inflammatory or immunosuppressive) [16]. It is still unclear whether imbalances among different subgroups also play an important role in COVID-19.

As a result of successful antiretroviral treatment over the last 20 years, HIV has become more of a chronic disease for practitioners to manage to require a routine clinical monitoring. Laboratory markers, such as the HIV-1 RNA viral load and CD4 cell count, are regularly used for patient management in addition to predicting disease progression and/or treatment outcomes [17-18]. In this study, the utility of the baseline CD4+ cell count as a predictor for COVID-19 disease progression in patients has been evaluated. But whether it is as a method for monitoring a patient's response to therapy, is still unclear. We hope to aid clinicians by examining the most recent literature and discussing the added value of the CD4 count in the management of patients with COVID-19 infection. Closer monitoring and more medical interventions may be needed for the elder and the patient with low CD4. This study still has some limitations: the patients involved in the study were with mild-to-moderate conditions only, no severe case was reported.

Conclusion

Compared with the symptoms of the initial patients with COVID-19 infection in Wuhan, those of patients from Shanghai in our study were relatively mild. Lung abnormalities on chest CT changed fast and showed the greatest severity approximately 10 days after the initial onset of symptoms. Low CD4 and older age are the main factors for the unsatisfactory imaging recovery, which requires more active medical intervention. It is essential for the patients to follow up once every two week after discharge from hospital after recovery.

321 **Abbreviations**

ENGLISH FULL NAME	ABBREVIATION	
area under the curve	AUC	323
complete blood count	CBC	324
coronavirus disease 2019	COVID-19	
C-reactive protein	CRP	
erythrocyte sedimentation rate	ESR	
ground glass opacity	GGO	
high-resolution CT	HRCT	
Interstitial lung diseases	ILD	
lactate dehydrogenase	LDH	
procalcitonin	PCT	
receiver operating characteristic curve	ROC	
severe acute respiratory syndrome	SARS	
severe acute respiratory syndrome coronavirus 2	SARS-CoV-2	

Declarations

Ethics approval and consent to participate

This study has been approved by Shanghai Public Health Center Ethics Committee.
(Petition no: YJ-2020-S035-01)

Consent for publication

Patients involved in Figures 5 and 6 had signed informed consent to publish.

Availability of data and material

The data will not be shared.

Funding

Not application.

Competing interests

The authors declare that they have no competing interests.

Authors' contributions

LW, YZ and FS participated in the design of the study, performed the statistical analysis and draft the manuscript. FL, NS and RZ participated in collecting data and HRCT scoring. JS and YXS conceived of the study, and participated in its design and coordination and helped to draft the manuscript. All authors read and approved the final manuscript.

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Table1: System for Scoring Ground-Glass Opacity, consolidation and Interstitial Opacity, on HRCT Scans

Score	System for scoring GGO, consolidation and interstitial opacity in HRCT scan
0	None
1	<5% of lobe
2	<25% of lobe
3	26-49% of lobe
4	50-75% of lobe
5	>75% of lobe

Table 2: Characteristics and clinical manifestations of the 207 patients with COVID-19.

Characteristics	All patients	Time since symptom onset				P value
		0-3days	4-7days	8-10days	>10days	
Number	207	68	83	32	24	
Age, years						ns
<18	2(1.0%)	1	0	1	0	
19-40	76(36.7%)	22	37	10	8	
41-65	91(44.0%)	30	34	15	12	
66-80	36(17.4%)	14	12	5	4	
>80	2(1.0%)	1	0	1	0	
Sex						ns
Female	105(50.7%)	35	42	16	12	
Male	102(49.3%)	32	41	16	13	
Wuhan contact	198(95.7%)	68	77	30	23	ns
Time from onset to hospitalization	5.3±3.9	2.0±0.9	5.0±1.1	8.8±0.8	13.2±2.8	ns
Average days of hospital stay	15.1±6.9	15.7±5.4	15.7±6.8	11.9±4.1	11.0±5.9	
>=4 CT scans	162(78.3%)	62	69	19	12	ns
Comorbidity						ns
Any	89(43.0%)	27	37	11	14	
Diabetes	15(7.2%)	5	4	3	3	
Hypertension	50(24.2%)	13	23	6	8	
Chronic liver disease	5(2.4%)	1	2	0	2	
COPD	3(1.4%)	2	1	0	0	
Cardiac disease	13(6.3%)	5	5	2	1	
Renal disease	3(1.4%)	1	2	0	0	
Signs & Symptoms					0	ns
Fever Highest temperature, °C						
TOTAL	188 *	47	75	25	17	
<37.30	24/188 (12.8%)	10	6	4	4	
37.30–38.00	92/188 (48.9%)	27	40	14	11	
38.10–39.00	64/188 (34.0%)	18	32	9	5	
>39.00	8 /188 (4.3%)	2	3	2	1	
Cough	81 (38.2%)	25	34	13	9	
Expectoration	43 (20.3%)	12	17	8	6	
Muscle ache	57 (26.9%)	17	26	8	6	
Dizziness and headache	23 (10.8%)	8	10	3	2	
Mild dyspnea or chest pain	16 (7.5%)	8	4	4	0	
Loss of appetite	15 (7.1%)	7	5	0	3	

Abdominal pain and diarrhea	9 (4.2%)	3	1	4	1
Nasal discharge	13 (6.1%)	3	4	1	5
Pharyngeal discomfort	16 (7.5%)	5	6	3	2
Nausea/ vomiting	8 (3.8%)	2	4	0	2

Data are n (%), n/N (%), mean (SD), where N is the total number of patients with available data.

COPD = Chronic obstructive pulmonary disease.*Have accurate record

Table3: Laboratory and physical examination results of the 207 patients with COVID-19.

Characteristics		All patients	Time since symptom onset			
			0-3days	4-7days	8-10days	>10days
		207	68	83	32	24
White blood cell count, × 10 ⁹ /L						
Normal or decreased		204(98.6%)	68 (100%)	80	30	24
Neutrophil count, × 10 ⁹ /L						0
Increased		24(11.6%)	5	12	4	3
Decreased		11(5.3%)	2	6	1	2
Neutrophil %						0
Increased		34(16.4%)	12	12	8	2
Decreased		5(2.4%)	2	2	1	0
Lymphocyte count, × 10 ⁹ /L						0
Decreased		103(49.8%)	29	49	15	10
Increased		2(1.0%)	0	2	0	0
Lymphocyte %						0
Decreased		65(31.4%)	19	25	13	8
Increased		5(2.4%)	1	2	1	1
CD4+	Decreased		27	48	15	10
		100(48.3%)				
C-reactive protein (mg/L)						
Increased		116(56.0%)	33	49	21	10
ESR		177(85.5%)	58	74	27	17
Procalcitonin (ng/mL)		0(0.0%)	0	0	0	0
Increased						
Fibrinogen		131(63.3%)	34	58	23	16
Increased						
D-Dimmer Increased		93(44.9%)	21	29	29	14
Haptoglobin		128(61.8%)	31	56	25	15
Increased						
ALT Increased		23(11.1%)	7	12	0	4
AST Increased		33(15.9%)	7	18	3	5
LDH Increased		84(40.6%)	22	37	15	9
Glutathione reductase		84(40.6%)	24	31	16	12
Increased						
Urine protein (positive)		63(30.4%)	22	25	13	3
Urine protein (positive>3+)		8(3.9%)	0	8	0	0

Table 4: First chest CT findings and CT score of the 207 patients with COVID-19.

			All patients	Time since symptom onset				P value
				0-3days	4-7days	8-10days	>10days	
Numbers			207	69	83	31	24	
Main features							0	ns
GGO	202(97.6%)		64	82	32	24		
Consolidation	127(61.4%)		33	55	21	18		
ILD	49(23.7%)		9	19	12	9		
Mixed pattern	136(65.7%)		34	57	23	22		
GGO+consolidation	90(43.5%)		28	38	12	12		
GGO+ILD	9(4.3%)		1	3	2	3		
GGO+consolidation+ILD	37(17.9%)		5	16	9	7		
Companion sign							0	
Crazy Paving Sign	114(55.1%)		34	45	24	11		ns
Nodules	33(15.9%)		9	17	2	5		<0.001
Single	3(1.4%)		3	0	0	0		
Multiple nodules	30(14.5%)		6	17	2	5		
Halo sign/Anti-halo sign	25(12.1%)		10	12	0	3		ns
Mediastinal lymphadenopathy	6(2.9%)		2	4	0	0		ns
Pleural effusion	3(1.4%)		1	2	0	0		ns
Pericardial effusion	7(3.4%)		4	3	0	0		ns
Score								ns
GGO	NA		4.1±3.5	5.6±3.1	5.6±2.4	5.4±3.4		
Consolidation	NA		1.4±2.0	2.0±2.3	2.1±1.9	2.0±0.7		
Interstitial opacity	NA		0.2±0.5	0.4±0.9	0.6±1.0	0.7±0.9		
Total score	NA		5.7±4.6	8.1±4.5	8.3±2.7	8.1±4.6		

Table 5: Chest CT distribution of the 207 patients with COVID-19.

		All patients	Time since symptom onset				
			0-3days	4-7days	8-10days	>10days	
Lung segment involved							
>= 5 segments	149(72.0%)	35	68	29	17	<0.001	
<5 segments	58(38.0%)	34	15	2	7		
Symmetry							
Bilateral	168(81.2%)	46	71	30	21	0.002	
Unilateral	39(18.8%)	23	12	1	3		
Distribution 1							
Multiple	190(91.8%)	57	80	30	23	0.033	
Focal	17(8.2%)	12	3	1	1		
Distribution 2							
Peripheral	160(77.3%)	59	59	24	18	ns	
Central	1(0.5%)	1	0	0	0		
Random	25(12.1%)	3	14	4	4		
Diffuse	21(10.1%)	6	10	3	2		

Table 6: The correlation between imaging outcomes in COVID-19 and biochemical indicators.

Indicators		Total CT outcome		GGO outcome		Consolidation outcome		ILD outcome	
		Sig.	Exp(B)	Sig.	Exp(B)	Sig.	Exp(B)	Sig.	Exp(B)
Previous disease	lung	.751	1.276	.290	2.281	.628	1.450	.197	3.042
Previous diseases	other	.502	1.199	.410	1.340	.524	1.183	.625	1.229
Age		.039	.982	.055	.977	.198	.989	.032	.971
WBC		.337	.569	.921	.932	.448	.648	.478	.561
Neutrophil count		.297	2.014	.873	1.141	.329	1.887	.323	2.593
lymphocytes count		.772	1.224	.886	.887	.912	.926	.575	.539
NLR		.424	0.883	.841	.956	.276	.854	.287	.778
Fibrinogen		.081	1.018	.823	.975	.096	1.018	.858	.975
D-dimer		.783	1.039	.438	1.348	.902	.985	.712	1.185
lactate dehydrogenase		.152	.997	.029	.993	.656	.999	.597	.998
C-reactive protein		.124	1.014	.298	1.009	.120	1.009	.104	.1014
ESR		.496	.998	.246	.996	.652	.999	.598	.997
CD4+ cell ratio		.816	1.003	.930	1.002	.903	1.002	.878	.997
CD4 cell count		.010	1.002	.049	1.002	.005	1.002	.013	1.004

Figure legends

Figure 1. Flow chart.

Figure 2. Seventy-six (37%) of the patients were aged 19-40 years, 91 (44%) were aged 41-65 years, 2 (1%) were aged 15 and 16 years, and 38 (17%) were aged 65 years and older.

Figure 3. A: Line graph shows median thin-section CT scores at various time points in Days after onset of symptoms. Scores peaked at Group 3 means 8-10 Days of illness, with a slow decline thereafter and substantial scores after the 10 days. B: Over time, the percent of mixed patterns has increased significantly. C: Crazy Paving Sign had the highest proportion in 8-10 days after onset of symptoms.

Figure 4. A: The number of involved lung segments increased gradually over time, reaching a peak in 8-10 days, and then gradually decreased. Group 1 (0-3 days, n=69); Group 2 (4-7 days, n=83); Group 3 (8-10 days, n=31); Group 4 (11-14 days, n=18); and Group 5 (>14 days, n=6). Subpleural focal GGO was showed at day 0-3, and developed into multiple lung lesions at 4-7 days after onset of symptoms.

Figure 5. High-resolution CT manifestations of selected 6 cases with Corona Virus Disease 2019 (CORVID-19). Case 1. 35-year-old male patient. HRCT scan was performed on day of admission (9 days after the onset of illness). (1A) shows a combined pattern of consolidations (blue arrow) and crazy paving sign (yellow arrows). (1B) shows areas of GGOs (red arrow) in right middle lobe. Case 2. 39-year-old male patient. (2A) HRCT scan was performed on day of admission (Day 2 after the onset of illness), which showed a subpleural distribution of consolidation (blue arrows) in the lingula and lower left lobe. Case 3. 63-year-old female. HRCT scan was performed on the day of admission (2 days after the onset of illness). (3A)

(3B) show a subpleural distribution of crazy paving sign (yellow arrow) in right lung.

Case 4. 49-year-old male patient. HRCT scan was performed on day of admission (Day 5 after the onset of illness). (4A) showed a combined pattern of consolidations (blue arrow) and crazy paving sign (yellow arrows) in both lobes. Case 5. 72-year-old male patient. HRCT was performed on 6 days after the onset of illness, (5A) showed a subpleural distribution of consolidation (blue arrow). Case 6. 72-year-old Female patient. HRCT was performed on day of admission (8 days after the onset of illness), (6A) showed a combined pattern of GGOs and interstitial opacity. Follow-up HRCT scans performed 16 days after the onset of illness, (6AB) showed fiber rope and fibrosis in both lower lobes (black arrows). 3A, 3B. Follow-up HRCT scans performed 3 days after admission (2C) (2D) show larger areas of mixed consolidations and GGOs (blue arrows) in the upper?? right lobe and both lower lobes.

Case 3. 50-year-old female. HRCT scan was performed on the day of admission (4 days after the onset of illness). (3A) (3B) show a subpleural distribution of GGOs (yellow arrow) and consolidations (blue arrows) in both lobes. Case 4. 43-year-old female. HRCT scan was performed on day of admission (3 days after the onset of illness). (4A) (4B) show a subpleural distribution of GGOs (yellow arrow) in both lobes. 1C, 1D. Follow-up HRCT scan performed 10 days after admission (1C) (1D) show remission of abnormalities, with reduced extent and density of airspace opacification, GGOs (yellow arrows) and fibrosis (black arrow).

Figure 6. a) 54-year-old male. HRCT scan was performed on day of admission (3 days after the onset of illness). (1A) (1B) (1C) (1D) show a subpleural distribution of GGOs in both lobes. (2A) (2B)(2C)(2D) Follow-up HRCT scan performed 7 days after the onset of illness, showed GGOs with increased lesion size and slightly increased density. Another follow-up HRCT scan performed 12 days after the onset of illness, (3A) (3B)(3C)(3D) showed GGO is partially absorbed, replaced by consolidation and fiber strands (blue arrow). Follow-up HRCT scan performed 26 days after the onset of illness, (4A) (4B)(4C)(4D) showed remission of abnormalities,

489 with reduced extent and density of GGOs (yellow arrows) and fibrosis (black arrow).

490 b) The CT score of this patient.

491

492 Figure 7. A cut-off value of 247 was obtained from ROC curve, and this cut-off value

493 yielded a sensitivity of 85% and a specificity of 40%. The area under curve (AUC)

494 value of the ROC curve is 0.568.

Figures

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Figure 2

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Figure 7

A cut off value of 247 was obtained from ROC curve, and this cut off value yielded a sensitivity of 85 % and a specificity of 40 %. The area under curve (AUC) value of the ROC curve is 0. 568.