Clinical and Radiographic Characteristics, Management and Short-term Outcomes of Patients with COVID-19 in Wenzhou, China

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Research Article

Keywords: COVID-19, Clinical, Radiographic Characteristics, SARS-cov-2, epidemiology

Posted Date: March 11th, 2020

DOI: <https://doi.org/10.21203/rs.3.rs-17032/v1>

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Version of Record: A version of this preprint was published at BMC Infectious Diseases on November 13th, 2020. See the published version at <https://doi.org/10.1186/s12879-020-05528-z>.

Abstract

Background: Coronavirus disease 2019 (COVID-19) is an emerging viral disease. Here, we reported the clinical features, management, and short-term outcomes of COVID-19 patients in Wenzhou, an area outside Wuhan.

Methods: Patients admitted to the Infectious Diseases Department of Ruian People's Hospital in Wenzhou, from January 21 to February 7, 2020, were recruited. Medical data on epidemiological history, demographics, clinical characteristics, laboratory tests, computerized tomography (CT) examination, treatment, and short-term outcomes were retrospectively reviewed. Blood biochemistry and routine tests were examined using standard methods and automatic machines. CT examination was performed again for several times during the hospitalization as necessary.

Results: A total of 67 confirmed COVID-19 cases were diagnosed; 64 (95.4%) were common cases and three (4.5%) severe cases. The most common symptoms at admission were fever (86.6%), cough (77.6%), productive cough (52.2%), chest distress (17.9%), and sore throat (11.9%), followed by diarrhea (7.4%), headache (7.4%), shortness of breath (6.0%), dizziness (4.5%), muscular soreness (4.5%), and running nose (4.5%). Thirty patients (47.8%) had increased C-reactive protein levels. The CT radiographs at admission showed abnormal findings in 54 (80.6%) patients. The patients were treated mainly by oxygen therapy and antiviral drugs. By February 17, 2020, none of the 67 patients died and no infection occurred among medical staff in the department. Fifty-four (80.6%) patients were completely recovered and all others were improving.

Conclusion: Cases in Wenzhou are mild, with good prognosis. Timely and appropriate screening, diagnosis, and treatment are the key to achieve the good outcomes.

Background

From December 2019, coronavirus disease (COVID-19) broke out in Wuhan, Hubei Province, China. The virus, once called 2019 novel coronavirus (2019-nCoV), was defined by the Coronavirus Study Group (CSG) of the International Committee as severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) on February 7, 2020 [1]. A modeling study reported by Wu *et al.* stated that as the virus was no longer contained within Wuhan, it could be outbroken in other major cities in China or even worldwide [2]. By February 17, 2020, on which we were preparing this report, the number of confirmed cases reached over 70000 with more than 1700 deaths worldwide; most were in Wuhan, Hubei province (<https://news.qq.com/zt2020/page/feiyan.htm>).

The earliest academic papers on the clinical characteristics of COVID-19 were published in late January by the *Lancet* [3, 4]. Up to 99 cases in Wuhan were reported with features of clustering onset and associated with ICU admission and a high mortality of from 11% to 15% [3, 4]. On 23 January, the World Health Organization estimated its death rate of 4% [5]. On Feb 11, 2020, the death rates is 2.9% in Hubei province according to the Novel Coronavirus Pneumonia Emergency Response Epidemiology Team of

China CDC [6]. However, there is no comprehensive descriptions and analysis on the clinical characteristics, management and prognosis of the COVID–19 cases outside the city of Wuhan.

Wenzhou is a commercial hub in Zhejiang Province, China. It is the most-affected city outside Hubei Province, with 503 confirmed cases on February 17, 2020 (<https://news.qq.com/zt2020/page/feiyan.htm>). These imported cases included both the “primary” cases coming from Wuhan, and those “secondary” cases infected by the “primary ones”. Whether the clinical characteristics of these cases are different from that of the cases in Wuhan is unknown. Therefore, the objective of this study was to report the clinical features, management, and short-term outcomes of patients with COVID–19 who were diagnosed in Wenzhou.

Methods

This is a retrospective study. The protocol of this study was approved by the Ethics Committee of the Third affiliated Hospital to Wenzhou Medical University (Ruian People’s Hospital) (No. YJ2020013). Written informed consent to participate was obtained from all patients included in the study.

Study population

There were approximately 180,000 Wenzhou people working and studying in Wuhan in 2019, and Ruian is a county-level city under the administration of Wenzhou City. According to incomplete statistics, more than 7,000 people returned to Ruian from Wuhan before Wuhan lockdown. All of these people were forcibly quarantined by the authorities for 14 days, and those with fever or respiratory symptoms were sent to the fever clinics. The nucleic-acid test was applied to those symptomatic patients by using throat mucus specimens collected with cotton swabs or deep-cough sputum, then they were quarantined in Ruian People’s Hospital until they were negative for the nucleic-acid test over 14 days. If the test was positive, the patient was diagnosed as a confirmed COVID–19 case. All confirmed cases were admitted to the isolation ward of the hospital. Moreover, all close contacts of each infected person were also forcibly quarantined and managed as described for those returned from Wuhan, and the nucleic-acid test was used for screening and confirmation for those with symptoms. Therefore, almost all people who were infected with the virus in Ruian would have been screened out, and thus all COVID–19 case would have been eventually identified.

For this retrospective, single-site study, we recruited patients at the Third Affiliated Hospital to Wenzhou Medical University (Ruian People’s Hospital) in Wenzhou, Zhejiang Province, from January 21 to February 7, 2020. Ruian People’s Hospital is a local comprehensive hospital, with about 2008 beds. On January 21, 2020, the hospital was named as a designated hospital, and all patents were admitted to the Infectious Diseases Department of the hospital, which provided quarantine wards with up to 90 beds, and equipped with a fresh air system for the management of COVID–19 patients. Strict infection-control measures were taken following the third edition of Prevention and Control Program for Pneumonia Caused by COVID–19

Diagnostic criteria

The following diagnostic criteria was based on the fourth edition of Diagnosis and Treatment program for Pneumonia Caused by COVID-19 by National Health Commission of the People's Republic of China.(
http://www.gov.cn/zhengce/zhengceku/2020-01/28/content_5472673.htm)

Suspected cases were diagnosed according to epidemiological history and clinical manifestations. Epidemiological history included the following three items: 1) travel or residence history in Wuhan or other places with COVID-19 onset within 14 days before the onset of the disease, 2) exposure to people coming from Wuhan or other places with COVID-19 onset who had a fever or respiratory symptoms within 14 days before the onset of the disease, and 3) onset cluster nature or epidemiological link to those with SARS-CoV-2 infection. Clinical manifestations included the following three items: 1) fever (armpit temperature of 37.2 C or higher), 2) radiographic findings (multiple small patchy shadows and interstitial changes appear in the early stage, with obvious extrapulmonary bands, and multiple ground glass infiltration and infiltrates to both lobes of the lung may further develop. Rarely, pulmonary consolidation and pleural effusion occur in severe cases.), and 3), white blood cell (WBC) counting (the total WBC number of white blood cells in the early stage of the disease is normal or $<3.5 \times 10^9/L$, or the lymphocyte count is $<1.1 \times 10^9/L$). Suspected cases were defined when any item of the epidemiological history plus two items of the clinical manifestations were met.

Confirmed cases were defined when the suspected case had one of the following etiological evidence: 1). Positivity for novel coronavirus nucleic acid as detected by real-time fluorescence-based RT-PCR of respiratory tract specimens, and 2), high homology with the known SARS-CoV-2 as detected by the virus gene sequencing test of respiratory tract specimens. Accordingly, the incubation period was calculated by the days from contacting with patient to symptoms occurring.

Patients with confirmed COVID-19 were further classified as common, severe and critically ill cases. Common cases were those with a fever and/or respiratory symptoms with or without radiographic signs of pneumonia. Severe cases were those with one of the following: 1), respiratory distress with respiratory rate more than 30 breaths per minute, 2) peripheral capillary oxygen saturation (SpO_2) value $\leq 93\%$, and 3), the partial pressure of oxygen (PaO_2)/fraction of inspired oxygen (FiO_2) $\leq 300\text{mmHg}$ ($1\text{mmHg} = 0.133\text{kPa}$). Critically ill cases were those with one of the following: 1), respiratory failure, with a need for mechanical ventilation, 2) shock, and 3), complication with other organ failure requiring ICU monitoring and treatment.

In addition, hypoxemia was defined as oxygen saturation (sO_2) $\leq 93\%$ or oxygenation index ≤ 300 mmHg. Leukopenia was defined as a WBC count $<3.5 \times 10^9/L$, thrombocytopenia as a platelet count less

than $125 \times 10^9/L$, and lymphopenia as a lymphocyte count $< 1.1 \times 10^9/L$.

Data collection

The medical data of all COVID-19 patients that were systematically recorded and stored in a network platform specifically established for SARS-CoV-2 infection and COVID-19 were reviewed retrospectively. The data on epidemiological history, demographics, clinical characteristics, laboratory tests, computerized tomography (CT) examination, treatment, and short-term outcomes were collected. Blood biochemistry and routine tests were examined using standard methods and automatic machines. CT examination was performed again or several times during the hospitalization as necessary. Two independent radiologists read and reported on all chest CT radiographs. Samples for SARS-CoV-2 assays (including nasopharyngeal swabs and sputum) were taken and sent to laboratories of the Ruian Centers for Disease Control (CDC). Then, all confirmed and suspected cases were reported to China CDC Disease Direct Reporting System.

Data analysis

Continuous data were described as mean and standard deviation (SD) and categorical variables were presented as count and percentage. Student's *t*-test was used to compare continuous variables and Fisher's exact test to the categorical variables. All analyses were performed using a statistical software package (Stata, version 12.0; Stata Corp. Texas, USA). A *p* value of < 0.05 was set as statistically significant.

Results

Demographic and clinical characteristics of patients

Overall, there was a total of 67 confirmed COVID-19 cases admitted to the Ruian People's Hospital from January 21 to February 7, 2020. Thirty-six (53.7%) patients were male. Five patients were diagnosed suspect patients and excluded from this study. The average age was 45.0 ± 15.2 years, ranging from 5 - 72 years. Thirty-four (50.7%) patients once lived in Wuhan ($n = 31$) or other cities of Hubei ($n = 3$) during December 1, 2019 and January 23, 2020. None of them was medical staff. The average incubation period was 5.1 ± 2.3 days in 30 patients; the incubation period was not traceable for the other 37 patients. The most popular comorbidities were hypertension (16.4%) and diabetes (0.5%). There were only three (4.5%) smokers and four (6.0%) alcohol abusers. One patient was pregnant, and one patient was under immunosuppressive therapy. The period from the onset to admission was 3.8 ± 2.3 days (Table 1). The most common symptoms at admission were fever (86.6%) with the mean armpit temperature of $37.3 \pm 0.8^\circ C$, cough (77.6%), productive cough (52.2%), chest distress (17.9%), and sore throat (11.9%), followed by diarrhea (7.4%), headache (7.4%), shortness of breath (6.0%), dizziness (4.5%), muscular soreness (4.5%), and running nose (4.5%) (Table 1).

There were 64 (95.4%) common cases and three (4.5%) severe cases. Compared to the common cases to that in severe cases, the severe cases were less likely to expose to Wuhan patients (21.9% vs. 66.7%, $p = 0.037$), more likely to have connective tissue disease (33.3% vs. 0%, $p = 0.045$), immunosuppressive therapy (33.3% vs. 0%, $p = 0.045$), chest distress (100% vs. 14.1%, $p = 0.005$), shortness of breath (66.7% vs. 3.1%, $p = 0.008$), and hypoxemia (100% vs. 0%, $p < 0.001$) (Table 1).

At admission, leukopenia occurred in 17 (25.4%) patients, and a decreased neutrophil count ($< 1.8 \times 10^9/L$) was found in 19 (28.3%) patients. Also, lymphopenia and thrombocytopenia were presented in 12 patients (17.9%) and eight (11.9%), respectively. One (1.5%) patient had an increased WBC count ($11.5 \times 10^9/L$) (Table 2).

In addition, 32 (47.8%) patients had increased C-reactive protein (CRP). Six (9.0%) patients had low partial pressure of oxygen (pO_2) and two (3.0%) had the partial pressure of carbon dioxide (pCO_2) (Table 2). Compare to the common cases, the severe cases had a significant increase in the levels of CRP ($p < 0.001$), gamma-glutamyl transpeptidase (GGT) ($p = 0.025$), creatine kinase (CK) ($p < 0.001$), lactate dehydrogenase (LDH) ($p < 0.001$), and activated partial thromboplastin time (aPTT) ($p = 0.007$) (Table 2).

Several laboratory parameters, including CRP, WBC, lymphocyte, alanine aminotransferase (ALT), aspartate aminotransferase (AST), and blood potassium (K^+), during the hospitalization period, were compared to their baseline data (Table 3). It was found that the third time check of the WBC had significantly increased ($p = 0.007$). However, there was no apparent fluctuation for other parameters for all the included patients (Table 3).

Transmission of SARS-CoV-2

All patients were traced for the potential source of SARS-CoV-2 infection. Four (6.0%) of the 67 patients were identified to be the origins that transmitted SARS-CoV-2 to four contacts who, in turn, transmitted the virus to other closely contacted peoples, respectively. Among the 31 patients, who returned to Ruian from Wuhan, three patients directly or indirectly transmitted to 16 patients, 9 patients and 4 patients, respectively (Figure 1). Three patients who returned to Ruian from other cities of Hubei Province did not transmit the infection to anyone else. Among the local patients, there was one case without clear source of infection, and three cases were infected by patients from Wuhan. However, all the four local patients did not transmit the infection to others.

Radiographic findings

The CT radiographs at admission showed abnormal findings in 54 (80.6%) of the 67 patients with peripheral-zone involvement in 40 (59.7%) patients, and middle and lower lobes and involvement in 31 (46.3%) patients. Bilateral involvement or multifocal lesions in 48 (88.9 %) (Figures 2). Of the 54 patients with abnormal findings, the most common infiltration patterns were focal consolidation ($n = 41$, 75.9%)

and ground-glass appearance (n = 13, 24.1%). Five (38.5%) of the 13 cases with normal CT at admission turned to have abnormal CT findings. Overall, the CT radiographic progression occurred in 20 (29.9%) patients, including the three severe cases, during the hospitalization (Figure 3).

Treatment

All 67 patients received antiviral drug therapy during their hospitalization. KALETRA® (lopinavir/ritonavir) (400 mg bid) was used in 62 (92.5%) patients, Umifenovir (200 mg tid) in 48 (71.6%) patients, aerosolized interferon- α (500 mIU bid) in 63 (94%), and oseltamivir (75 mg bid) in one (1.5%) patient until the nucleic-acid test became negative. Oxygen therapy (3 L/min) was performed in 41 (61.2%) patients until the symptoms improved. No patients received mechanical ventilation. Of the three severe cases, two (66.7%) received glucocorticoid therapy. One (33.3%) was treated with methylprednisolone due to CT imaging progression and hypoxemia until his conditions improved. The dose of methylprednisolone injection was 80 mg for three days, then 40 mg for two days, and finally 20 mg for one day. The other severe case received the methylprednisolone 120 mg for one day because of the same reason and was later transferred to the First Affiliated Hospital of Wenzhou Medical University for further treatment. His symptoms improved now. Immunoglobulin and plasma were not used in all patients. Only 8 (11.9%) patients who were considered to have secondary bacterial infection were treated with antibiotics treatment (Table 4).

Short-term outcome

By February 17, 2020, there was no death among the 67 patients and no infection among medical staff in the department. Fifty-four (80.6%) patients were completely recovered and discharged from the hospital and their average hospitalization stay was 9.0 ± 3.0 days. Other patients, including the three severe cases, were improving.

Discussion

The present study supplied the current first-line data, including clinical and radiographic features, treatment, and short-term outcomes of COVID-19 patients in the Wenzhou area, which is outside of Wuhan where the epidemic started. Of the 67 COVID-19 cases admitted to our department from January 21 to February 7, 2020, only three were severe cases and 64 were common cases. On February 17, 54 patients were completely recovered and discharged from the hospital, and all the others, including the three severe cases, were improving. Importantly, based on the transmission patterns among the included patients and the recently reported cases, SARS-CoV-2 infection showed highly contagious [6–9].

In the present study, more than half (53.7%) of patients were male and the high proportion of the patients appeared in the age ranges of 19–45 (49.3%) and 46~65 (32.8%) years. Thus, it seems that the male adults are more likely to be infected by this SARS-CoV-2. Theoretically, adolescents and older adults

should be vulnerable due to the biological nature. However, there was only one boy (5 years old) and no very elderly patients (>80 years) in the present study. One possible reason is that young and middle-aged adults have more social activities, and thus increased opportunity to be exposed to the infection sources. Compared to the first two clinical studies on COVID-19 patients in the Wuhan area, the age of our patients was younger, but male predominance was not that apparent [3, 4], which may represent one of the demographic characteristics of patients out of Wuhan, although more data from other cities are needed to confirm this hypothesis.

The top three symptoms in the cohort were fever (86.6%), cough (77.6%), and productive cough (52.2%), which is consistent with the findings of the first recent reports on the patients with SARS-CoV-2 infection [3, 4]. In addition, the rate of diarrhea in our cohort was 7.5%, which is higher than that (2%~3%) reported in the recent two papers [3, 4]. In contrast, the rate of diarrhea in patients with SARS-CoV-1 pneumonia, which outbreak 17 years ago, was very high (23.6~41.7%) [10, 11]. These findings indicate that, compared to SARS-CoV-1, SARS-CoV-2 impacts less on the digestive system.

In the present study, there were only 4.5% (3/67) severe cases, which was much less than that reported in the recent two papers [3, 4]. We found that exposed to Wuhan patients, connective tissue disease, having immunosuppressive therapy, chest distress, shortness of breath, and hypoxemia were associated to severity of the disease. However, since there were only three severe cases in the present study, these findings need to be interpreted with caution, although chest distress and shortness of breath, and the condition of hypoxemia are obviously the main manifestations in severe cases.

In the present study, leukopenia, abnormal neutrophil count, lymphopenia, and thrombocytopenia were observed in 25.4%, 28.3%, 17.9% and 11.9% of patients, respectively, at admission. These findings suggest that a decrease in the WBC count remains to be one of the clinical features of virus infection [12] although the WBC count may be within the normal range in most of patients infected with SARS-CoV-2. In addition, we observed that the WBC count was significantly increased during hospitalization. However, Chen *et al.* reported that 24% of their 99 Wuhan patients had increased leucocyte level, which may reflect that the disease was in the advanced stage in their cohort [3]. Another apparent characteristic of COVID-19 patients is that the temperature was not very high at primary stage ($37.3 \pm 0.8^{\circ}\text{C}$), regardless of the severity of the disease, suggesting that although fever was the most frequent symptom, some patients with normal temperature should not be ignored. In addition 47.8% of patients had increased CRP levels, which is consistent with the report from Chen *et al.*, reporting that CRP increased in 86% of their patients [3]. CRP is known as a common laboratory marker of systemic inflammation [13]. In addition, compare to the common cases, the severe cases had significantly increased levels of GGT, CK, LDH and aPTT. Therefore, these biomarkers may be used for the prediction of the severity of the disease, and more extensive studies are required to further explore the hypothesis.

CT has been proven to be accurate to diagnose SARS-CoV-2 pneumonia [14–18]. Unlike the other two recent studies [3, 4] where all patients were diagnosed by radiography, 13 (19.3%) cases in our cohort had normal CT and eight of them remained normal during the hospital stay. One of the reasons may be the

low severity degree of disease in our patients; it is possible that SARS-CoV-2 outside Wuhan city may tend to be less toxic after the further “person-to-person” transmission although this hypothesis also needs to be verified.

We treated our patients mainly by oxygen therapy and antiviral drugs. Only two severe cases were given glucocorticoid therapy. This management is different from that for SARS-CoV-1, for which corticosteroid therapy was performed in all their patients [10]. Now, all of the 67 patients were either completely recovered or significantly improving. Compared to the reported rate of patients receiving ICU care (26%) and mortality rate (4.3%) in Wuhan [19], most of our patients were milder and the outcomes were better both with the rates of 0%. Our observation is consistent with the reported findings outside Wuhan in China even abroad [20, 21]. We speculate that this phenomena may be related to the following reasons: 1), The time from the onset to the hospitalization of our patients was 3.8 ± 2.3 days, and they were usually screened and stayed as a “suspected patient” in the observation ward 1–2 days before admission to hospital. Therefore, our patients had, on average, received rest, symptomatic, oxygen, and antiviral therapy within three days of the onset, which are critical to improving prognosis; and 2), In the present study, severity of the disease was associated with the exposure to patients from Wuhan, suggesting that with the passage, virulence and pathogenicity of the virus gradually decreases. Again, the above speculation needs to be verified by more extensive studies.

To our best knowledge, this is the first clinical report on SARS-CoV-2 outside the Wuhan area. Wenzhou is the most affected area outside of Hubei Province, and the patients in this area would be of high representativity for those outside the Wuhan area. The limitation of the study is the unavoidable bias due to the small sample size. A further collection of related data is needed to confirm our findings.

Conclusions

COVID-19 is an emerging and high infectious viral disease. Cases in the Wenzhou area are milder, with better prognosis, compared to those in Wuhan. Timely and appropriate screening, diagnosis, and treatment are the key to achieve the good outcomes.

List Of Abbreviations

COVID-19: Coronavirus disease 2019; CT: computerized tomography; 2019-nCoV: 2019 novel coronavirus; CSG: Coronavirus Study Group; SARS-CoV-2: severe acute respiratory syndrome coronavirus 2; WBC: white blood cell; SpO₂: peripheral capillary oxygen saturation; PaO₂: partial pressure of oxygen; FiO₂: fraction of inspired oxygen; sO₂: oxygen saturation; CDC: Centers for Disease Control; SD: standard deviation; CRP: C-reactive protein; GGT: gamma-glutamyl transpeptidase; LDH: lactate dehydrogenase; CK: creatine kinase; aPTT: activated partial thromboplastin time; ALT: alanine aminotransferase; AST: aspartate aminotransferase.

Declarations

Ethics approval and consent to participate

The protocol of this study was approved by the Ethics Committee of the Third affiliated Hospital to Wenzhou Medical University (Ruian People's Hospital) (No. YJ2020013). Written informed consent was obtained from all patients included in the study.

Consent for publication

It is not applicable as this is a retrospective study.

Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

Funding

This work was supported by a fund of Ruian Science and Technology Bureau: MS2020023 and MS2020025. The funding bodies had no role in the design of the study, the collection, analysis, or interpretation of the data, or writing the manuscript.

Acknowledgments

The authors would like to thank all the involved study investigators for dedicating their time and skills to the completion of this study. The authors would also like to thank Medjaden Bioscience Limited for assistance in the preparation of the manuscript.

Authors' Contributions

Concept and design: QS, JD, LH, XX, SX, XZ, RZ, YH and ZR; Acquisition, analysis, or interpretation of data: EY, XW, SZ, YW, LD, FC and XL; Drafting of the manuscript: LH, EY and GS; Critical revision of the manuscript for important intellectual content: QS and JD; Statistical analysis: EY, GS; Obtained funding: QS and XW; QS, JD, EY had full access to all of the data in the study and take responsibility for the

integrity of the data and the accuracy of the data analysis. All authors read and approved the final manuscript.

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Tables

Table 1. Characteristics of 67 patients with COVID-19

Characteristic	All patients (n=67)	Common patients (n=64)	Severe patients (n=3)
Gender			
Female	31 (46.3)	30 (46.9)	1 (33.3)
Male	36 (53.7)	34 (50.7)	2 (66.7)
Age (years)			
5~ 15	3 (4.5)	3 (4.7)	0
16~ 18	1(1.5)	1(1.6)	0
19 ~ 45	33 (49.3)	32 (47.8)	1 (33.3)
46~ 65	22 (32.8)	20 (29.9)	2 (66.7)
65~72	8 (11.9)	8 (12.5)	0
Exposure history			
Lived in Wuhan*	31 (46.3)	31 (48.4)	0
Lived in other cities in Hubei province	3 (4.5)	2 (3.1)	1 (33.3)
Exposed to patients in Wuhan	16 (23.9)	14 (21.9)	2 (66.7)
Exposed to local patients	15 (22.4)	15 (23.4)	0
Exposed to local carriers	1 (1.5)	1(1.6)	0
No epidemic history	1 (1.5)	1 (1.6)	0
Incubation periods (days)#			
	5.3±3.0 (n=34)	5.3±3.1 (n=33)	3.5±0.7 (n=1)
Period from onset to admission (days)			
	3.8±2.3	3.8±2.4	4.0±1.7
Comorbid illness			
Cardiovascular disease	1 (1.5)	1(1.6)	0
Digestive system disease	4 (6.0)	4 (6.3)	0
Malignant tumor	1 (1.5)	1(1.6)	0
Nervous system disease	0	0	0
Respiratory system disease	1 (1.5)	1(1.6)	0
Kidney disease	0	0	0
Hypertension	11(16.4)	11 (17.2)	0
Diabetes	7 (10.5)	7 (10.9)	0

Connective tissue disease*	1 (1.5)	0	1(33.3)
Smoking			
No smoking history	62 (92.5)	59 (92.2)	3 (100)
Have quit smoking	2 (3.0)	2 (3.1)	0
Smoking	3 (4.5)	3 (4.7)	0
Alcohol			
No alcohol abuse history	61(91.0)	58 (90.6)	3 (100)
Have quit drinking	2 (3.0)	2 (3.1)	0
Have alcohol abuse	4 (6.0)	4 (6.2)	0
Immunosuppressive therapy*	1 (1.5)	0	1 (33.3)
Pregnancy	1 (1.5)	1(1.6)	0
Symptoms			
Fever	58 (86.6)	55 (85.9)	3 (100)
Headache	2 (3.0)	2 (3.1)	0
Dizziness	3 (4.5)	3 (4.7)	0
Muscular soreness	3 (4.5)	2 (3.1)	1 (33.3)
Running nose	3 (4.5)	3 (4.7)	0
Sore throat	8 (11.9)	8 (12.5)	0
Cough	52 (77.6)	49 (76.6)	3 (100)
Productive cough	35 (52.2)	32 (50.0)	3 (100)
Chest distress*	12 (17.9)	9 (14.1)	3 (100)
Shortness of breath*	4 (6.0)	2 (3.1)	2 (66.7)
Abdominal pain	2 (3.0)	2 (3.1)	0
Diarrhea	5 (7.4)	5 (7.8)	0
Nausea or vomiting	2 (3.0)	2 (3.1)	0
Armpit temperature (°C)	37.3±0.8	37.3±0.8	37.5±0.3
CT diagnosed as pneumonia (n = 65)			
No	13 (19.4)	13 (20.3)	0
Yes	54 (80.6)	51(79.7)	3(100)

Complications			
Hypoxemia*	3 (4.5)	0	3 (100)

Data are expressed as mean± standard deviation or number (%), where appropriate.

Abbreviation: SD standard deviation, CT computerized tomography.

#, available for 34 cases, including 31 common cases and three severe cases.

* $p < 0.05$, compared between common and severe cases.

Table 2. The baseline laboratory test results of all 67 study patients with COVID-19

Assay (normal range)	All patients (n=67 or specified)	Common patients (n=64 or specified)	Severe patients (n=3 or specified)
ALT (9-50 U/L)	31.0±31.6	30.3±32.0	46.0±17.0
AST (15-40 U/L)	29.0±18.5	28.3±18.6	45.0±6.2
ALP (45-125 U/L)	79.8±43.1	79.8±44.0	79.3±20.1
GGT (10-60 U/L)	37.3±44.8	35.0±42.3	86.7±77.9
ALB (40-55 g/L)	41.5±5.2	41.5±5.3	40.8±1.7
TP (60-85 g/L)	69.6±5.8	69.6±5.8	71.7±5.2
GLO (20-40 g/L)	28.6±3.9	28.5±3.9	30.9±3.7
A/G (1.2 - 2.4)	1.5±0.2	1.5±0.2	1.3±0.1
TBIL (0-23 mmol/L)	9.1±4.6	9.1±4.6	9.8±4.2
IBIL (1.2-16 mmol/L)	5.3±3.2	5.3±3.2	5.5±3.0
DBIL (0-8 mmol/L)	3.8±1.6	3.8±1.6	4.3±1.2
TBA (0-10 mmol/L)	6.8±14.5	7.0±14.8	3.5±2.1
PALB (0.2-0.43 g/L)	0.2±0.1	0.2±0.1	0.1±0.04
CHE (4.62-11.5 KU/L)	8.8±2.0	8.8±2.0	10.3±1.3
GLU (3.9-6.1 mmol/L)	6.1±1.3	6.1±1.3	6.1±0.7
BUN (3.6-9.5 mmol/L)	3.9±1.0	4.0±1.0	3.6±0.8
CREA (mmol /L)	65.1±11.0	65.3±11.2	62.3±4.9
K ⁺ (3.5-5.3 mmol/L)	3.7±0.4	3.8±0.4	3.7±0.2
Na ⁺ (137-147mmol/L)	138.9±2.5	139.0±2.4	136.6±3.4
CK (50-310 U/L)	100.9±115.4	88.8± 69.9	359.7±424.5
CK-MB (0-24 U/L)	23.2±19.9	22.6±20.1	35.7±13.3
LDH (120-250 U/L)	223.0±68.4	215.6±59.3	380.3±68.5
TG (0.56-1.7 mmol/L)	1.3±0.7	1.3±0.7	1.46±0.3
CHO (3.1-5.2 mmol/L)	4.2±0.9	4.2±0.9	4.5±0.3

HDL-C (1.03-3.0 mmol/L)	1.0±0.3	1.0±0.3	1.0±0.2
LDL-C (2.1-3.12mmol/L)	2.7±0.7	2.7±0.8	3.1±0.3
CRP (0-6mg/L)	12.1±19.3↑	9.8±13.8↑	61.3± 50.2↑
PT (10-13.5 seconds)	11.0±0.7	11.0±0.7	11.0±0.1
PTA (70-140%)	100.4±10.0	100.4±10.3	99.4±1.4
INR (0.85 – 1.15)	1.0±0.1	1.0±0.1	1.0±0.006
aPTT (22-36 seconds)	31.8±4.4	31.5±4.1	37.9±8.5
FIB (2.0-4.0g/L)	3.8±2.6	3.8±2.6	5.0±0.7
CT (14-21 seconds)	16.9±0.7	16.9±0.7	16.6±0.6
D-Dimer (0-0.5ug/mL)	0.3±0.3	0.3±0.4	0.3±0.1
WBC (3.5-9.5*10 ⁹ /L)	4.7±1.8	4.7±1.8	4.4±0.9
Lymphocyte (1.1-3.2*10 ⁹ /L)	1.4±0.6	1.5±0.6	0.9±0.3
Neutrophils (1.8-6.3*10 ⁹ /L)	2.8±1.4	2.7±1.4	3.3±0.8
RBC (4.3-5.8*10 ¹² /L)	4.5±0.5	4.5±0.5	4.9±0.5
Hgb (130-175 g/L)	135.1±16.9	134.7±17.0	145.0±12.8
HCT (40-50 %)	39.4±4.2	39.3±4.2	42.7±2.6
Platelets (125-350*10 ⁹ /L)	194.8±71.9	197.4±72.1	139.7±46.5
Blood PH (7.350-7.450)	7.4±0.03(n=62)	7.4±0.03 (n=59)	7.4±0.008
pO ₂ (80-100 mmHg)	105.8±27.8(n=62)	106.6±27.6(n=59) ↑	89.8±33.5
pCO ₂ (35-45 mmHg)	39.2±3.4(n=62)	39.3±3.4(n=59)	36.4±1.2
sO ₂ (91.9-99.0 %)	97.4±1.8(n=62)	97.5±1.6(n=59)	94.8±3.7
HCO ₃ ⁻ (21-27mmol/L)	24.5±2.0(n=62)	24.5±2.1 (n=59)	23.7±0.4
AG (8- 16 mmol/L)	10.9±2.2(n=62)	11.0±2.2 (n=59)	10.5±2.2

Lac (0.5-1.7 mmol/L)	1.7±0.6(n=62)	1.7±0.6(n=59)	1.7±0.6
PCT (<0.5 ng/ml)	0.2±0.08 (n=56)	0.2±0.08(n= 54)	0.24±0 (n=2)
BNP (0-100.0 pg/ml)	12.2±6.4 (n=59)	12.3±6.5 (n=56)	10.0±0
cTnl (0.00-0.08 ng/ml)	0.004±0.007 (n=60)	0.004±0.008 (n=57)	0.003±0.002
CD3 (690-1760/ul)	1088.3±451.8 (n=46)	1101.2±448.3 (n=45)	509 (n=1)
CD4 (410-884/ul)	621.2±287.1 (n=46)	627.0±287.6 (n=45)	357 (n=1)
CD8 (190-658/ul)	384.9±182.1(n=46)	390.4±180.2 (n=45)	135 (n=1)
NK cells (90-536/ul)	339.4±175.5(n=46)	339.8±177.5 (n=45)	324(n=1)
CD19 (90-323/ul)	211.2±187.9(n=46)	212.6±189.8 (n=45)	145(n=1)

Data are expressed as mean± standard deviation.

Abbreviation: ALT the Alanine Aminotransferase test, AST the aspartate aminotransferase test, ALP the alkaline phosphatase test, GGT the gamma-glutamyl transpeptidase test, ALB the albumin test, TP the total protein test, GLO Globulin test, A/G the albumin globulin ratio, TBIL the total bilirubin test, IBIL the indirect bilirubin, DBIL the direct bilirubin test, TBA the thiobarbituric acid test, PALB the partner and localizer of BRCA2, CHE the cholinesterase test, GLU the blood glucose test, BUN the blood urea nitrogen test, CREA the creatinine blood test, K⁺ the potassium blood test, Na⁺ the sodium blood test, CK the creatine kinase blood test, CK-MB creatine kinase myocardial band, LDH the lactate dehydrogenase, TG Triglycerides, CHO Cholesterol, HDL-C High-density lipoprotein cholesterol, LDL-C the low-density lipoprotein cholesterol test, CRP C-reactive protein, PT the prothrombin time, PTA the pure-tone audiogram, INR International normalized ratio test, aPTT the activated partial thromboplastin time, FIB(fibrinogen) CT clotting time, WBC white blood cell, RBC red blood cell, Hgb the hemoglobin, HCT the hematocrit blood test, pO₂ Partial Pressure of Oxygen, pCO₂ the partial pressure of carbon dioxide, sO₂ oxygen saturation, HCO₃⁻ bicarbonate test, AG the anion gap, Lac the lactic acid blood test, PCT procalcitonin, BNP Brain natriuretic peptide, cTnl the troponin test,, CD cluster of differentiation, NK cells Natural killer cells, SD standard deviation.

Table 3. Dynamic changes of the laboratory parameters in 67 patients with COVID-19 during hospitalization

Assay (normal range)	At Admission	During Hospitalization	
		Second test	Third test
WBC (3.5-9.5 *10 ⁹ /L)	4.7±1.8	5.1±1.45	5.6±1.8*
Lymphocyte (1.1-3.2*10 ⁹ /L)	1.4±0.6	1.5±0.6	1.5±0.4
ALT (9-50 U/L)	31.0±31.6	27.8±25.0	28.8±22.2
AST (15-40 U/L)	29.0±18.5	25.5±14.5	23.8±11.2
K ⁺ (3.5-5.3 mmol/L)	3.7±0.4	3.6±0.4	3.7±0.3
CRP (0-6 mg/L)	12.1±19.3	11.9±20.6	10.0±16.7

Data are expressed as mean± standard deviation.

Abbreviation: WBC white blood cell, CRP C-reactive protein.

* $p < 0.05$, compared between third test and at admission.

Table 4. Treatment of 67 patients with COVID-19.

Treatment	All patients (n=67)	Common patients (n=64)	Severe patients (n=3)
Oxygen therapy	41 (61.2)	39 (60.9)	3 (100)
Mechanical ventilation	0	0	0
CRRT	0	0	0
ECMO	0	0	0
Antibiotics	8 (11.9)	7 (10.9)	1 (33.3)
Antifungals	0	0	0
Antiviral drug			
KALETRA (Lopinavir / Ritonavir)	62 (92.5)	59 (92.2)	3 (100)
Umifenovir	48 (71.6)	46 (71.8)	2 (66.7)
Aerosolized α interferon	66 (98.5)	63 (98.4)	3 (100)
Oseltamivir	1 (1.5)	1 (1.6)	0
Glucocorticoid therapy	2 (3.0)	0	2 (66.7)

Data are expressed as number (%).

Abbreviation: CRRT Continuous Renal Replacement Therapies, ECMO Extracorporeal membrane oxygenation.

Figures

Figure 1

A The transmission diagrams of SARS-CoV-2 for three super spreaders. Patients numbers were coded based on the date of the onset. B The transmission diagrams of SARS-CoV-2 for three super spreaders. Patients numbers were coded based on the date of the onset. C The transmission diagrams of SARS-CoV-2 for three super spreaders. Patients numbers were coded based on the date of the onset.

Figure 2

Transverse chest computed tomography (CT) images. (A), The CT images from a women (age range: 55-59 years old) at admission show bilateral ground-glass opacity with the blurred border; (B), The CT images from a women (age range: 45-49 years old) at admission show multiple patchy ground-glass shadows in both lungs, mainly under the pleura in the lower lobe of both lungs, with signs of anti-halo.

Figure 3

Chest computed tomography (CT) images from a man (age range: 40-44 years old) who is severe patient showing disease progression. (A&B), at admission, transverse chest CT images show small ground-glass opacity in the left lower lobe and high-density shadows with blurred edges; (C&D), In the observation ward the day before admission, transverse chest CT images show multiple patchy and density of nodules with blurred border, mainly distributed in the subpleural area, indicating progression from the previous one;

(E&H), Transverse chest CT images after 14-days treatment with negative nucleic acid test three times show increased multiple patches and stripes in the two lungs with blurred borders, with the prominent distribution in the subpleural area, and apparent fibrous foci.