Observational Study

Medicine®

OPEN

Corona Virus Disease 2019 patients with different disease severity or age range

A single-center study of clinical features and prognosis

Lingyun Ren, MD, Dan Yao, MB, Zuowei Cui, MM, Shanshan Chen, MD, Hong Yan, MM*

Abstract

This study aimed to describe clinical characteristics and prognosis of Corona Virus Disease 2019 (COVID-19) patients, and to compare these features among COVID-19 patients with different disease severity or age range.

Totally, 129 COVID-19 patients were retrospectively enrolled, and the information about demographics, comorbidities, medical histories, clinical symptoms, and laboratory findings at the time of hospital admission were collected. Meanwhile, their clinical outcomes were recorded. According to the fourth version of the guidelines on the Diagnosis and Treatment of COVID-19 by the National Health Commission of China, patients were divided into subgroups according to disease severity (moderate and severe/critical) or age (<40 years, 40–64 years and ≥65 years).

In total patients, the most common clinical symptoms were fever and cough (all incidences over 50%). Other common clinical symptoms included tiredness/anorexia, shortness of breath, dyspnea, aching pain, expectoration, diarrhea, shivering, and nausea/vomiting. The mortality rate was 5.4%, and the median value of hospital stay was 16.0 (11.0–23.0) days. Subgroup analyses disclosed that severe/critical patients exhibited increased neutrophil count, neutrophils, C-reactive protein, calcitonin, alpha-hydroxybutyric dehydrogenase, lactate dehydrogenase, aspartate aminotransferase, gamma-glutamyl transferase, creatinine, and D-dimer levels, and more deaths compared with that in moderate patients. Regarding age, it correlated with more common fever, higher levels of red blood cell, neutrophil count, lymphocyte count, neutrophils, red cell volume distribution width standard deviation-coefficient of variation, calcitonin, alpha-hydroxybutyric dehydrogenase, Creatine Kinase, aspartate aminotransferase, gamma-glutamyl transferase, and D-dimer, raised death rate and prolonged hospital stay.

Our findings provide valuable evidence regarding clinical characteristics and prognosis of COVID-19 patients to help with the understanding of the disease and prognosis improvement.

Abbreviations: α-HBDH = alpha-hydroxybutyric dehydrogenase, AST = aspartate aminotransferase, COVID-19 = Corona Virus Disease 2019, CK = Creatine Kinase, CRP = C-reactive protein, GGT = gamma-glutamyl transferase, LDH = lactate dehydrogenase, RBC = red blood cell, RDW-CV = red cell volume distribution width standard deviation-coefficient of variation, SARS-CoV-2 = severe acute respiratory syndrome coronavirus-2, % = percentages.

Keywords: age, clinical symptoms, Corona Virus Disease 2019, disease severity, prognosis

1. Introduction

Corona Virus Disease 2019 (COVID-19) is a highly infectious disease caused by severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2), which has been officially declared by World Health Organization in March 2020 as a global public health emergency.[1] With the major route of respiratory transmission by airborne spittle and contact transmission, COVID-19 spreads very quickly and widely.[2] Up to April 23, 2020, the COVID-19 pandemic has caused 2,471,136 confirmed cases and 169,006 deaths in over 200 countries.[3] In order to control this disease, multiple interventions have been implemented, including improved rates of diagnostic testing, clinical management (such as antiviral therapy, symptomatic therapy, and traditional Chinese medicine therapy), isolation of suspected cases/confirmed cases contacts, and mobility restrictions.[4] However, this pandemic outbreak is still ongoing. Hence, more efforts to prevent and control COVID-19 pneumonia are essential both in China and globally.

Based on the current epidemiological investigation, the incubation period is generally 3-7 days, and the longest incubation period is no more than 14 days.[5] Common

Editor: Jian Liu.

The authors have no conflicts of interest to disclose.

All data generated or analyzed during this study are included in this published article [and its supplementary information files].

Department of Anesthesiology, The Central Hospital of Wuhan, Tongji Medical College, Huazhong University of Science and Technology, Wuhan, P.R. China.

** Correspondence: Hong Yan, Department of Anesthesiology, The Central Hospital of Wuhan, Tongji Medical College, Huazhong University of Science and Technology, No.26, Shengli Street, Wuhan 430014, P.R. China (e-mail: yanqiaomei545@126.com).*

How to cite this article: Ren L, Yao D, Cui Z, Chen S, Yan H. Corona Virus Disease 2019 patients with different disease severity or age range: a single-center study of clinical features and prognosis. Medicine 2020;99:49(e22899).

Received: 13 May 2020 / Received in final form: 7 July 2020 / Accepted: 19 September 2020

http://dx.doi.org/10.1097/MD.0000000000022899

symptoms reported in COVID-19 patients are fever, dry cough, and fatigue. For severe COVID-19 patients, they are reported to present with dyspnea and bilateral ground-glass opacities on chest CT, severe acute respiratory distress syndrome, septic shock, metabolic acidosis, and coagulation dysfunction.[5] Accumulated studies illustrate that COVID-19 is featured with human-to-human transmission, and it is caused by SARSCoV-2 infection that is able to result in severe and even fatal acute respiratory distress syndrome.[2,6,7] In order to increase the understanding of COVID-19 and help with the improvement of prognosis, we analyzed detailed clinical data from patients with laboratory-confirmed COVID-19 infection in The Central Hospital of Wuhan, Tongji Medical College, Huazhong University of Science and Technology. Herein, this study aimed to describe clinical characteristics and prognosis in COVID-19 patients, and then compare these features among COVID-19 patients with different disease severity or age range.

2. Methods

2.1. Patients

A total of 129 patients with laboratory-confirmed COVID-19 infection admitted to The Central Hospital of Wuhan, Tongji Medical College, Huazhong University of Science and Technology, between January 20, 2020 and February 4, 2020 were retrospectively analyzed in this study. All patients were diagnosed as COVID-19 according to the diagnostic criteria of the guidelines on the Diagnosis and Treatment of COVID-19 by the National Health Commission of China (fourth version) (available at: http://www.nhc.gov.cn/). As suggested in the guideline, the suspected case was defined as a patient with any 1 of the following epidemiological histories and any 2 of the following clinical manifestations:

(1) epidemiological histories: (a) a living or travel history to Wuhan or other districts where the virus was continued to spread by local cases, within 14 days before illness onset; (b) direct contacting with patients who had fever or respiratory symptoms from Wuhan or other districts where virus was continued to spread by local cases, within 14 days before illness onset; (c) there was clustering incidence of COVID-19; (d) there was epidemiological association with COVID-19 patients;
(2) clinical manifestations: (a) fever; (b) there was imageology character of febrile pneumonia; (c) the total number of white blood cells in the early stage of the illness onset was normal or decreased, or the lymphocyte count was reduced. A suspected case was confirmed as COVID-19 patient if 1 of following conditions occurred: (a) a positive result of real-time reverse transcriptase–polymerase chain reaction assay of throat-swab or blood sample; (b) gene sequencing for throat-swab or blood sample indicated that the viral sequences were highly homologous to the novel coronavirus. The study was approved by the Ethics Committee of our hospital, and patients or their families provided informed consents.

2.2. COVID-19 severity classification

According to the fourth version of the guidelines on the Diagnosis and Treatment of COVID-19 by the National Health Commission of China, COVID-19 severity was classified as follows:

(1) Moderate type: fever and respiratory symptoms are presented with pneumonia on chest computed tomography.
(2) Severe type: one of the following conditions had to be met: (a) respiratory distress, respiratory rate $\geq$30 per minute; (b) oxygen saturation on quiescent condition $\leq$93%; (c) partial pressure of oxygen in arterial blood/fraction of inspired oxygen $\leq$300 mm Hg.
(3) Critical type: one of the following conditions had to be met: (a) respiratory failure occurred and mechanical ventilation was required; (b) shock occurred; (c) patients with other organ dysfunction needing intensive care unit monitoring and treatment.

Based on the above clinical classification criteria, 20 patients were classified as moderate type; 6 patients were classified as severe type; 3 patients were classified as critical type.

2.3. Data collection

Medical records of COVID-19 patients were reviewed. The following characteristics at the time of hospital admission were collected, including

(1) demographics: age, and gender;
(2) comorbidities: hypertension, diabetes, hyperlipidemia, chronic pneumopathy, cardiovascular disease, renal dysfunction, and fatty liver;
(3) medical histories: tumor history, and surgical history;
(4) clinical symptoms: fever, cough, expectoration, tiredness/anorexia, diarrhea, nausea/vomiting, shortness of breath, dyspnea, aching pain, and shivering;
(5) laboratory findings: white blood cell, red blood cell (RBC), hemoglobin, platelet, neutrophil count, lymphocyte count, monocytes count, eosinophil, basophil, packed cell volume, mean corpuscular volume, mean corpuscular hemoglobin, mean corpuscular-hemoglobin concentration, red cell volume distribution width-standard deviation, red cell volume distribution width standard deviation-coefficient of variation (RDW-CV), platelet distribution width, mean platelet volume, platelet large cell ratio, plateletcrit, C-reactive protein (CRP), calcitonin, alpha-hydroxybutyric dehydrogenase (α-HBDH), lactate dehydrogenase (LDH), Creatine Kinase (CK), alanine transaminase, aspartate aminotransferase (AST), gamma-glutamyl transferase (GGT), urea, creatinine, and D-dimer.

Besides, treatments after admission and outcomes up to March 23, 2020 were also extracted from the medical records. For treatment after admission, all patients were administered with broad-spectrum coronavirus antiviral therapy, anti-infection therapy, and supportive care. Outcomes included duration of hospital stay, discharge from hospital, remained in hospitalization, transferred to other hospital for further treatment, and death.

2.4. Statistical analysis

SPSS software (Version 22.0, IBM) was used for statistical analysis. Continuous variables described as median with interquartile range, and categorical variables were displayed as count and percentages (%). In order to ensure statistical power, severe type patients, and critical type patients were merged into 1 group in analysis. Comparison between moderate patients and

severe/critical patients was determined by Wilcoxon rank sum test or Chi-square test. Correlations of patients' age with clinical symptoms, laboratory findings, and outcomes were determined by Spearman rank correlation test. All tests were two-tailed, and P-value $< .05$ was considered as statistically significant.

3. Results

3.1. COVID-19 patients' characteristics

In total patients, the median age was 50.0 (34.5–61.0) years, and there were 45 (34.9%), 66 (51.2%) and 18 (14.0%) patients with age <40 years, 40-64 years and ≥65 years, respectively. There were 62 (48.1%) males and 67 (51.9%) females (Table 1). As to comorbidities, 31 (24.0%), 16 (12.4%), 2 (1.6%), 6 (4.7%), 3 (2.3%), 3 (2.3%), and 3 (2.3%) patients were with hypertension, diabetes, hyperlipidemia, chronic pneumopathy, cardiovascular disease, renal dysfunction, and fatty liver, respectively. As for medical history, 12 (9.3%) patients had tumor history and 25 (19.4%) patients had surgical history.

According to COVID-19 severity (from the fourth version of the guidelines on the Diagnosis and Treatment of COVID-19 by the National Health Commission of China), patients were classified into moderate type and severe/critical type. Compared to moderate patients (44.0 (32.5—55.5) years), the median age was increased in severe/critical patients (59.5 (48.8–64.0) years) ($P < .001$). Meanwhile, the number of cases with comorbidity of hypertension ($P = .007$) and renal dysfunction ($P = .028$) was higher in severe/critical patients compared to moderate patients. Furthermore, there was no difference in other demographics, comorbidities, and medical histories between moderate patients and severe/critical patients. The detailed information was shown in Table 1.

3.2. COVID-19 patients' clinical symptoms

In total patients, the most common clinical symptoms were fever (N = 108 [83.7%]) and cough (N = 78 ([60.5%]), and their incidences were all over 50%. Besides, other common clinical symptoms included tiredness/anorexia (N = 33 [25.6%]), shortness of breath (N = 18 [14.0%]), dyspnea (N = 30 [23.3%]), aching pain (N = 25 [19.4%]), expectoration (N = 36 [27.9%]), diarrhea (N = 15 [11.6%]), shivering (N = 13 [10.1%]), and nausea/vomiting (N = 8 [6.2%]). The frequency of tiredness/anorexia was more common in severe/critical patients compared to moderate patients ($P = .003$). However, no difference was found in other clinical symptoms between moderate patients and severe/critical patients. The detailed information was shown in Table 2.

3.3. COVID-19 patients' laboratory findings

In total patients, the median value of white blood cell, neutrophil count, lymphocyte count, neutrophils lymphocyte was 4.56 (3.53–5.99) $\times 10^9$/L, 3.34 (2.74–4.28) $\times 10^9$/L, 1.14 (0.83–1.56) $\times 10^9$/L, 72.80 (61.40–83.60) %, and 20.60 (13.00–29.60) %, respectively. As to inflammation index, the median value of CRP was 7.25 (1.96–19.07) mg/L and the median value of calcitonin was 0.05 (0.03–0.09) μg/L. As for myocardial enzyme, the median value of α-HBDH, LDH, and CK was 146.50 (130.00–189.00) U/L, 191.50 (164.25–323.75) U/L, and 66.00 (50.00–109.00) U/L, respectively. In terms of liver function indexes, the median value of alanine transaminase, AST, and GGT was 20.50 (14.83–30.88) U/L,

24.50 (19.00–34.10) U/L and 22.70 (15.80–40.80) U/L, respectively. Regarding renal function indexes, the median value of urea and creatinine was 3.94 (3.01–5.03) mmol/L and 65.00 (54.30–75.00) μmol/L, respectively. Additionally, the value of D-dimer was 0.37 (0.24–0.67) μg/L.

Compared to moderate patients, neutrophil count ($P = .024$), neutrophils ($P = .006$), CRP ($P = .010$) calcitonin ($P = .028$), α-HBDH ($P < .001$), LDH ($P < .001$), AST ($P < .001$), GGT ($P = .004$), creatinine ($P = .028$), and D-dimer ($P = .004$) were elevated, while lymphocyte count ($P = .015$) and lymphocyte ($P = .005$) were decreased in severe/critical patients. However, laboratory characteristics were similar between moderate

Table 1

Demographics, comorbidities, and medical histories of COVID-19 patients.

Characteristics	Total patients (N = 129)	Moderate patients (N = 89)	Severe/critical patients (N = 40)	*P*-value
Demographics				
Age (yr), median (IQR)	50.0 (34.5-61.0)	44.0 (32.5-55.5)	59.5 (48.8–64.0)	<.001
Age group, No. (%)				.011
<40 yr	45 (34.9)	38 (42.7)	7 (17.5)	
40-64 yr	66 (51.2)	42 (47.2)	24 (60.0)	
≥65 yr	18 (14.0)	9 (10.1)	9 (22.5)	
Gender, No. (%)				.107
Male	62 (48.1)	47 (52.8)	15 (37.5)	
Female	67 (51.9)	42 (47.2)	25 (62.5)	
Comorbidities				
Hypertension, No. (%)	31 (24.0)	15 (16.9)	16 (40.0)	.007
Diabetes, No. (%)	16 (12.4)	9 (10.1)	7 (17.5)	.239
Hyperlipidemia, No. (%)	2 (1.6)	0 (0.0)	2 (5.0)	.094
Chronic pneumopathy, No. (%)	6 (4.7)	5 (5.6)	1 (2.5)	.437
Cardiovascular disease, No. (%)	3 (2.3)	1 (1.1)	2 (5.0)	.177
Renal dysfunction, No. (%)	3 (2.3)	0 (0.0)	3 (7.5)	.028
Fatty liver, No. (%)	3 (2.3)	1 (1.1)	2 (5.0)	.227
Medical histories				
Tumor history, No. (%)	12 (9.3)	7 (7.9)	5 (12.5)	.402
Surgical history, No. (%)	25 (19.4)	15 (16.9)	10 (25.0)	.279

COVID-19 = Corona Virus Disease 2019, IQR = interquartile range.

Table 2

Clinical symptoms of COVID-19 patients.

Symptoms	Total patients (N = 129)	Moderate patients (N = 89)	Severe/critical patients (N = 40)	*P*-value
Fever, No. (%)	108 (83.7)	73 (82.0)	35 (87.5)	.436
Cough, No. (%)	78 (60.5)	51 (57.3)	27 (67.5)	.273
Tiredness/anorexia, No. (%)	33 (25.6)	16 (18.0)	17 (42.5)	.003
Shortness of breath, No. (%)	18 (14.0)	10 (11.2)	8 (20.0)	.184
Dyspnea, No. (%)	30 (23.3)	17 (19.1)	13 (32.5)	.116
Aching pain, No. (%)	25 (19.4)	15 (16.9)	10 (25.0)	.279
Expectoration, No. (%)	36 (27.9)	25 (28.1)	11 (27.5)	.945
Diarrhea, No. (%)	15 (11.6)	10 (11.2)	5 (12.5)	.836
Shivering, No. (%)	13 (10.1)	7 (7.9)	6 (15.0)	.213
Nausea/vomiting, No. (%)	8 (6.2)	3 (3.4)	5 (12.5)	.106

COVID-19 = Corona Virus Disease 2019.

patients and severe/critical patients. The detailed information was shown in Table 3.

3.4. COVID-19 patients' outcomes

In total patients, 7 (5.4%) cases died, meanwhile 95 (73.6%) cases discharged from hospital, 19 (14.7%) cases remained in hospital and 8 (6.2%) cases were transferred to other hospital. The median value of hospital stay was 16.0 (11.0–23.0) days.

Compared to moderate patients, more cases died ($P = .001$) and were transferred to other hospital ($P = .005$), while less cases discharged from hospital ($P < .001$) in severe/critical patients. Whereas no difference in hospital stays ($P = .1000$) or number of cases remained in hospital ($P = .095$) was observed between moderate patients and severe/critical patients. The detailed information was shown in Table 4.

3.5. Comparison of clinical symptoms among age groups

Fever occurred more frequently in older patients ($P = .065$). Whereas no correlation of age with other clinical symptoms was found (all $P > .05$). The detailed information was shown in Table 5.

3.6. Comparison of laboratory findings among age groups

Age positively correlated with RBC ($P = .015$), neutrophil count ($P = .002$), lymphocyte count ($P < .001$), neutrophils ($P = .044$), RDW-CV ($P = .045$), calcitonin ($P = .011$), α-HBDH ($P < .001$), LDH ($P < .001$), CK ($P = .014$), AST ($P = .008$), GGT ($P = .028$), and D-dimer ($P = .004$) levels, while negatively correlated with lymphocyte ($P = .042$). However, there was no correlation of age with other laboratory findings (all $P > .05$). The detailed information was shown in Table 6.

3.7. Comparison of outcomes among age groups

Age was correlated with increased death rate ($P < .001$), prolonged hospital stay ($P = .028$), and decreased hospital discharge ($P < .001$). However, no correlation of age with other clinical outcomes was displayed (all $P > .05$). The detailed information was shown in Table 7.

4. Discussion

SARS-CoV-2 belongs to a unique clade of the sarbecovirus subgenus of the Orthocoronavirinae subfamily, which has been identified as the pathogen of COVID-19.[8] Its genetic features are obviously different from SARS-CoV and MERS-CoV, while the homology of SARS-CoV-2 with bat-SL-CoVZC45 is more than 85%.[9] Recent evidence displays that SARS-CoV and MERS-CoV originated in bats, and SARS-CoV-2 likely originated in bats as well.[9] Although the pathogenesis of highly pathogenic COVID-19 is still not completely understood, it has been reported to be similar with MERS-CoV and SARS coronavirus infection, with a rapid progression to respiratory failure.[10–12]

It is now clear that COVID-19 spreads via human-to-human transmission, and this epidemic has been gradually growing in recent weeks. Thus, it is urgent to facilitate efforts to prevent and control COVID-19 pneumonia. Here, we provided an initial assessment of epidemiologic characteristics and prognosis in COVID-19 patients. In this study, we reported that the common clinical symptoms were fever and cough, whose incidences were over 50% in COVID-19 patients, among these symptoms, fever was the most common symptom in COVID-19 patients. Our findings were similar in previous studies reported in COVID-19 patients.[5] Also, these symptoms are also similar with these in patients with MERS-CoV and SARS coronavirus infection.[11,12] In addition, we found that the median value of hospital stay was 16.0 (11.0–23.0) days, and 5.4% patients died. The results were in line with previous studies that mortality rate ranges from 2.0% to 4.4%.[13]

To further analyzed and detailed the clinical data in COVID-19 patients, we divided patients into moderate type, severe type, and critical type according to their disease severity. We found that there was no difference in clinical symptoms between moderate patients and severe/critical patient. Whereas it is notable that severe/critical patients showed an increased trend to occur with tiredness/anorexia compared to moderate patients, which might be explained by that as disease severity manifested, the damage in respiratory and digestive system function was exacerbated in COVID patients. In addition, we discovered that systemic organ indexes (such as neutrophil count, neutrophils, lymphocyte count, lymphocyte calcitonin, α-HBDH, LDH, AST, GGT, creatinine, creatinine, and D-dimer) were related to disease severity in COVID-19 patients, which suggested that COVID-19 patients had impaired cardiac, liver, hematological and cellular immune system function. Based on one previous study, levels of T lymphocytes, D-dimer, C-reactive protein, aspartate aminotransferase, myohemoglobin, CD3+, CD4+, and CD8+ correlated with COVID-19 severity.[7] Although the findings regarding systemic organ indexes are different between our study and previous study, our findings also suggest the damage in cardiac,

Table 3

Laboratory findings of COVID-19 patients.

Indexes, median (IQR)	Total patients (N = 129)	Moderate patients (N = 89)	Severe/critical patients (N = 40)	*P*-value
Blood routine				
WBC ($\times 10^9$/L)	4.56 (3.53–5.99)	4.50 (3.43–5.76)	4.85 (3.97–6.30)	.196
RBC ($\times 10^{12}$/L)	4.61 (4.19–5.08)	4.64 (4.22–5.09)	4.53 (4.12–5.07)	.430
HBG (g/L)	138.00 (125.00–149.00)	138.50 (125.00–149.50)	137.00 (124.00–149.00)	.765
Platelet ($\times 10^9$/L)	168.00 (146.00–214.00)	178.00 (149.00–219.00)	159.5 (134.0–193.25)	.081
Neutrophil count ($\times 10^9$/L)*	3.34 (2.74–4.28)	3.27 (2.59–4.15)	3.37 (2.95–5.54)	.024
Lymphocyte count ($\times 10^9$/L)	1.14 (0.83–1.56)	1.27 (0.94–1.77)	0.83 (0.60–1.16)	<.001
Monocytes count ($\times 10^9$/L)*	0.27 (0.21–0.44)	0.30 (0.19–0.48)	0.21 (0.13–0.33)	.450
Eosinophil ($\times 10^9$/L)*	0.01 (0.00–0.06)	0.01 (0.00–0.05)	0.00 (0.00–0.07)	.452
Basophil ($\times 10^9$/L)*	0.01 (0.01–0.02)	0.01 (0.01–0.02)	0.01 (0.01–0.02)	.913
Neutrophils (%)*	72.80 (61.40–83.60)	68.80 (59.85–80.98)	81.50 (63.90–89.45)	.006
Lymphocyte (%)*	20.60 (13.00–29.60)	22.20 (16.33–31.08)	13.00 (8.00–28.75)	.005
Monocytes (%)*	6.20 (2.90–7.90)	6.55 (3.75–8.53)	5.30 (1.85–6.50)	.094
Eosinophil (%)*	0.10 (0.00–1.20)	0.25 (0.00–1.23)	0.00 (0.00–1.00)	.305
Basophil (%)*	0.20 (0.20–0.30)	0.20 (0.18–0.40)	0.30 (0.20–0.30)	.789
PCV (%)*	38.60 (36.70–44.50)	38.50 (36.65–42.63)	43.70 (36.85–44.95)	.346
MCV (fl)*	89.90 (87.60–92.90)	90.85 (88.35–94.05)	89.70 (85.10–92.70)	.383
MCH (pg)*	29.80 (28.80–30.90)	29.90 (29.18–31.00)	29.00 (27.70–30.85)	.962
MCHC (g/L)*	333.00 (324.00–336.00)	334.50 (325.25–336.50)	325.00 (322.50–335.00)	.370
RDW-SD (fl)*	39.90 (38.10–41.30)	39.50 (37.95–41.50)	41.00 (39.15–44.80)	.311
RDW-CV (%)*	12.50 (11.90–12.90)	12.05 (11.80–12.98)	12.60 (12.55–14.05)	.125
PDW (%)*	16.20 (14.20–16.30)	16.05 (13.85–16.38)	16.20 (13.75–16.30)	.156
MPV (fl)*	10.30 (9.10–10.80)	10.50 (9.10–10.83)	10.00 (8.90–10.55)	.408
P-LCR (%)*	27.50 (19.30–32.20)	28.80 (19.23–32.65)	25.30 (20.15–30.50)	.480
PCT (%)*	0.20 (0.16–0.22)	0.20 (0.13–0.23)	0.20 (0.16–0.22)	.368
Inflammation index				
CRP (mg/L)	7.25 (1.96–19.07)	5.82 (1.38–17.00)	16.20 (6.28–43.52)	.010
Calcitonin (μg/L)*	0.05 (0.03–0.09)	0.04 (0.03–0.07)	0.09 (0.05–1.15)	.028
Myocardial enzyme				
α-HBDH (U/L)	146.50 (130.00–189.00)	142.00 (123.00–167.00)	267.00 (167.00–373.00)	<.001
LDH (U/L)	191.50 (164.25–323.75)	183.00 (159.00–242.00)	424.00 (231.00–679.00)	<.001
CK (U/L)	66.00 (50.00–109.00)	62.00 (48.00–98.00)	85.00 (55.50–188.25)	.073
Liver function index				
ALT (U/L)	20.50 (14.83–30.88)	19.00 (12.00–27.00)	29.00 (18.00–47.90)	.001
AST (U/L)	24.50 (19.00–34.10)	22.00 (18.00–28.30)	36.80 (26.70–61.50)	<.001
GGT (U/L)	22.70 (15.80–40.80)	22.00 (14.70–32.50)	40.10 (20.00–57.00)	.004
Renal function index				
Urea (mmol/L)	3.94 (3.01–5.03)	3.81 (2.94–4.95)	4.82 (3.32–5.51)	.069
Creatinine (μmol/L)	65.00 (54.30–75.00)	61.80 (54.08–73.00)	78.30 (56.00–94.00)	.028
Other index				
D-dimer (μg/L)	0.37 (0.24–0.67)	0.31 (0.24–0.51)	0.58 (0.38–0.79)	.004

α-HBDH = alpha-hydroxybutyric dehydrogenase, ALT = alanine transaminase, AST = aspartate aminotransferase, CK = Creatine Kinase, COVID-19 = Corona Virus Disease 2019, CRP = C-reactive protein, GGT = gamma-glutamyl transferase, HBG = hemoglobin, IQR = interquartile range, LDH = lactate dehydrogenase, MCV = mean corpuscular volume, MCH = mean corpuscular hemoglobin, MCHC = mean corpuscular-hemoglobin concentration, MPV = mean platelet volume, PCT = plateletcrit, PCV = packed cell volume, PDW = platelet distribution width, P-LCR = platelet large cell ratio, RBC = red blood cell, RDW-SD = red cell volume distribution width-standard deviation, RDW-CV = red cell volume distribution width standard deviation-coefficient of variation, WBC = white blood cell.

* Only 29 COVID-19 patients recorded those indexes.

Table 4

Outcomes of COVID-19 patients.

Symptoms	Total patients (N = 129)	Moderate patients (N = 89)	Severe/critical patients (N = 40)	*P*-value
Hospital stay (d), median (IQR)	16.0 (11.0–23.0)	16.0 (11.0–22.0)	20.0 (11.0–27.0)	.100
Discharged from hospital, No. (%)	95 (73.6)	84 (94.4)	11 (27.5)	<.001
Remained in hospital, No. (%)	19 (14.7)	10 (11.2)	9 (22.5)	.095
Transferred to other hospital, No. (%)	8 (6.2)	2 (2.2)	6 (15.0)	.005
Death, No. (%)	7 (5.4)	1 (1.1)	6 (15.0)	.001

COVID-19 = Corona Virus Disease 2019.

Table 5

Clinical symptoms among age groups of COVID-19 patients.

Symptoms	<40 yr (N = 45)	40-64 yr (N = 66)	≥65 yr (N = 18)	*P*-value
Fever, No. (%)	37 (82.2)	59 (89.4)	12 (66.7)	.065
Cough, No. (%)	23 (51.1)	46 (69.7)	9 (50.0)	.090
Tiredness/anorexia, No. (%)	9 (20.0)	18 (27.3)	6 (33.3)	.496
Shortness of breath, No. (%)	6 (13.3)	8 (12.1)	4 (22.2)	.542
Dyspnea, No. (%)	10 (22.2)	13 (19.7)	7 (38.9)	.228
Aching pain, No. (%)	8 (17.8)	14 (21.2)	3 (16.7)	.860
Expectoration, No. (%)	10 (22.2)	24 (36.4)	2 (11.1)	.061
Diarrhea, No. (%)	7 (15.6)	6 (9.1)	2 (11.1)	.579
Shivering, No. (%)	3 (6.7)	9 (13.6)	1 (5.6)	.386
Nausea/vomiting, No. (%)	3 (6.7)	5 (7.6)	0 (0.0)	.491

COVID-19 = Corona Virus Disease 2019.

Table 6

Laboratory findings among age groups of COVID-19 patients.

Indexes, median (IQR)	<40 years (N = 45)	40-64 years (N = 66)	≥65 years (N = 18)	*P* value
Blood routine				
WBC ($\times 10^9$/L)	4.50 (3.23–6.19)	4.50 (3.73–6.05)	4.83 (3.53–5.73)	.822
RBC ($\times 10^{12}$/L)	4.75 (4.46–5.22)	4.59 (4.19–5.06)	4.16 (3.83–4.80)	.015
HBG (g/L)	143.00 (129.00–150.00)	138.00 (125.00–151.00)	125.00 (122.00–148.00)	.286
Platelet ($\times 10^9$/L)	189.00 (154.00–226.25)	164.00 (144.00–200.00)	162.00 (131.00–196.25)	.155
Neutrophil count ($\times 10^9$/L)*	2.71 (1.65–4.70)	3.34 (2.81–4.28)	4.00 (3.81–5.40)	.002
Lymphocyte count ($\times 10^9$/L)	1.37 (1.12–1.87)	1.12 (0.77–1.44)	0.87 (0.51–1.02)	<.001
Monocytes count ($\times 10^9$/L)*	0.27 (0.14–0.44)	0.30 (0.21–0.44)	0.21 (0.16–0.42)	.837
Eosinophil ($\times 10^9$/L)*	0.01 (0.00–0.03)	0.00 (0.00–0.08)	0.01 (0.01–0.04)	.873
Basophil ($\times 10^9$/L)*	0.00 (0.00–0.00)	0.02 (0.01–0.02)	0.01 (0.01–0.02)	.784
Neutrophils (%)*	67.50 (48.60–83.65)	72.80 (55.20–81.50)	75.50 (71.35–83.55)	.044
Lymphocyte (%)*	23.00 (11.30–44.10)	20.20 (13.00–35.50)	22.00 (13.20–22.20)	.042
Monocytes (%)*	6.50 (3.95–8.25)	6.20 (4.10–7.90)	2.90 (2.45–6.70)	.356
Eosinophil (%)*	0.40 (0.00–0.85)	0.00 (0.00–1.20)	0.10 (0.05–0.45)	.716
Basophil (%)*	0.20 (0.15–0.35)	0.30 (0.20–0.40)	0.20 (0.15–0.25)	.189
PCV (%)*	39.00 (37.45–40.50)	38.40 (36.70–44.60)	38.10 (37.20–41.95)	.724
MCV (fl)*	92.90 (86.45–93.55)	89.70 (88.60–92.80)	91.80 (88.75–93.55)	.522
MCH (pg)*	29.60 (29.00–30.80)	30.00 (28.80–31.50)	29.70 (28.60–30.50)	.703
MCHC (g/L)*	333.00 (322.50–335.00)	335.00 (325.00–339.00)	323.00 (322.00–326.00)	.665
RDW-SD (fl)*	39.60 (38.45–40.60)	39.90 (37.40–41.30)	42.10 (40.75–45.20)	.092
RDW-CV (%)*	12.00 (11.85–12.65)	12.60 (11.80–12.90)	12.60 (12.40–14.00)	.045
PDW (%)*	15.90 (12.95–17.40)	16.00 (12.80–16.30)	16.30 (16.25–16.30)	.801
MPV (fl)*	10.70 (9.10–10.95)	10.00 (9.00–10.80)	10.30 (9.55–11.80)	.535
P-LCR (%)*	31.60 (18.90–33.70)	25.30 (19.10–31.90)	27.50 (24.35–37.05)	.642
PCT (%)*	0.17 (0.12–0.21)	0.21 (0.16–0.24)	0.20 (0.17–0.22)	.493
Inflammation index				
CRP (mg/L)	5.03 (0.73–15.14)	11.70 (3.45–19.60)	6.60 (3.17–35.19)	.120
Calcitonin (μg/L)*	0.04 (0.03–0.04)	0.05 (0.03–0.09)	0.09 (0.08–1.13)	.011
Myocardial enzyme				
α-HBDH (U/L)	130.00 (105.50–141.50)	166.00 (141.25-196.75)	170.50 (151.25–347.75)	<.001
LDH (U/L)	165.00 (146.00–188.00)	210.00 (172.75–318.75)	365.00 (191.00–510.00)	<.001
CK (U/L)	57.00 (42.00–81.00)	74.00 (50.50–111.50)	108.50 (55.50–208.25)	.014
Liver function index				
ALT (U/L)	17.80 (10.00–25.00)	22.00 (15.25–32.75)	26.60 (16.95–36.80)	.061
AST (U/L)	20.00 (17.00–27.80)	26.00 (20.50–34.60)	32.00 (22.85–42.80)	.008
GGT (U/L)	19.40 (14.00–29.50)	30.00 (17.00–45.00)	22.00 (16.90–40.95)	.028
Renal function index				
Urea (mmol/L)	3.80 (2.71–4.89)	3.89 (3.00–5.04)	5.08 (3.79–11.20)	.059
Creatinine (μmol/L)	59.45 (51.25–74.25)	66.00 (56.00–75.75)	64.80 (54.18–76.98)	.566
Other index				
D-dimer (μg/L)	0.27 (0.22–0.39)	0.41 (0.25–0.74)	0.53 (0.34–1.36)	.004

α-HBDH = alpha-hydroxybutyric dehydrogenase, ALT = alanine transaminase, AST = aspartate aminotransferase, CK = Creatine Kinase, COVID-19 = Corona Virus Disease 2019, CRP = C-reactive protein, GGT = gamma-glutamyl transferase, HBG = hemoglobin, IQR = interquartile range, LDH = lactate dehydrogenase, MCV = mean corpuscular volume, MCH = mean corpuscular hemoglobin, MCHC = mean corpuscular-hemoglobin concentration, MPV = mean platelet volume, PCT = plateletcrit, PCV = packed cell volume, PDW = platelet distribution width, P-LCR = platelet large cell ratio, RBC = red blood cell, RDW-SD = red cell volume distribution width-standard deviation, RDW-CV = red cell volume distribution width standard deviation-coefficient of variation, WBC = white blood cell.

* Only 29 COVID-19 patients recorded those indexes.

Table 7

Outcomes in age groups of COVID-19 patients.

Symptoms	<40 yr (N=45)	40–64 yr (N=66)	≥65 yr (N=18)	*P*-value
Hospital stay (d), median (IQR)	15.0 (10.0–22.5)	16.0 (11.0–21.3)	21.0 (14.5–39.5)	.028
Discharged from hospital, No. (%)	43 (95.6)	46 (69.7)	6 (33.3)	<.001
Remained in hospital, No. (%)	2 (4.4)	13 (19.7)	4 (22.2)	.054
Transferred to other hospital, No. (%)	0 (0.0)	6 (9.1)	2 (11.1)	.099
Death, No. (%)	0 (0.0)	2 (3.0)	5 (27.8)	<.001

COVID-19 = Corona Virus Disease 2019.

liver, hematological and cellular immune system of COVID-19 patients. The possible explanation about different findings in systemic organ indexes between our study and that previous study was due to poor statistical power caused by relatively sample size and varying diagnostic criteria from different version of the guidelines on the Diagnosis and Treatment of COVID-19 by the National Health Commission of China (fourth version in our study vs fifth version in that previous study).[9] For clinical outcomes, severe/critical patients were more frequently to be transferred to other hospital, and eventually dead, which suggested worse prognosis in severe/critical patients.

In order to further explore the correlation of age with clinical characteristics, we divided patients into subgroups based on different age range (<40 years, 40–64 years and ≥65 years), and then we compared the clinical characteristic among them. In this study, fever occurred more frequently in older patients. Of note, patients with age ≥65 years might present with moderate to light fever and even without fever. Regarding laboratory findings, we disclosed the positive correlation of age with RBC, neutrophil count, neutrophils, RDW-CV, CRP, calcitonin, α-HBDH, LDH, CK, AST, GGT, and D-dimer in COVID-19 patients, which suggested that the damage of cardiac, liver, hematological and cellular immune system function deteriorated with age in COVID-19 patients. Furthermore, we also explored the association of age with clinical outcomes in COVID-19 patients, and we discovered that age positively correlated with increased death rate and prolonged hospital stay, which indicated that older age might be a critical index contributing to mortality risk, and the reasons might be that:

(1) older patients are related to a higher frequency of comorbidities (including hypertension, diabetes, chronic pneumopathy, and cardiovascular disease), which might indirectly affect the progression of COVID-19 and increase the difficulty in the treatment of COVID-19 patients, thus, older patients might be related to worse prognosis.[14–16]
(2) older patients were featured with less robust immune responses that devoted into worse prognosis and even death[17,18];
(3) older patients had increased risk of drug resistance to attenuate the drug efficacy, thereby, leading to poor treatment outcomes and higher mortality risk.[19]

This finding was in line with previous study that also reveals obviously lower survival rate in COVID-19 patients over 75 years old compared to the younger patients.[7]

There were several limitations. One is that this was an observational study with a small sample size, potential bias, and residual confounding might exist. Another one is that all patients were just from our hospital, hence, further study with more patients from multicenter is needed.

5. Conclusion

In conclusion, fever, cough, tiredness/anorexia are common clinical symptoms and the mortality rate is 5.4% in COVID-19 patients. Besides, further subgroup analyses discover that severe/critical patients present with multiple organ dysfunction and immune dysfunction, importantly, older age might be a critical index contributing to worse disease severity and higher mortality risk.

Author contributions

XXXX.

References

[1] WHO Director-General's opening remarks at the media briefing on COVID-19-11 March 2020 [Internet]. World Health Organization. 2020 [cited 4 April 2020]. Available at: https://www.who.int/dg/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19—11-march-2020.
[2] Li Q, Guan X, Wu P, et al. Early transmission dynamics in Wuhan, China, of novel coronavirus-infected pneumonia. N Engl J Med 2020;382:1199–207.
[3] Coronavirus disease 2019 (COVID-19) Situation Report – 94 [Internet]. World Health Organization. 2020 [cited 23 April 2020]. Available at: https://www.who.int/emergencies/diseases/novel-coronavirus-2019/situation-reports/.
[4] Kraemer MUG, Yang CH, Gutierrez B, et al. The effect of human mobility and control measures on the COVID-19 epidemic in China. Science 2020.
[5] Siordia JAJr. Epidemiology and clinical features of COVID-19: a review of current literature. J Clin Virol 2020;127:104357.
[6] Aghagoli G, Gallo Marin B, Soliman LB, et al. Cardiac involvement in COVID-19 patients: risk factors, predictors, and complications: a review. J Card Surg 2020.
[7] Feng Y, Ling Y, Bai T, et al. COVID-19 with different severity: a multi-center study of clinical features. Am J Respir Crit Care Med 2020.
[8] Zhu N, Zhang D, Wang W, et al. A novel coronavirus from patients with pneumonia in China, 2019. N Engl J Med 2020; 382:727–33.
[9] The guidelines on the Diagnosis and Treatment of COVID-19 by the National Health Commission of China (Fourth Version). 2020.
[10] Grasselli G, Pesenti A, Cecconi M. Critical care utilization for the COVID-19 outbreak in Lombardy, Italy: early experience and forecast during an emergency response. JAMA 2020.
[11] Assiri A, Al-Tawfiq JA, Al-Rabeeah AA, et al. Epidemiological, demographic, and clinical characteristics of 47 cases of Middle East respiratory syndrome coronavirus disease from Saudi Arabia: a descriptive study. Lancet Infect Dis 2013;13:752–61.
[12] Peiris JS, Chu CM, Cheng VC, et al. Clinical progression and viral load in a community outbreak of coronavirus-associated SARS pneumonia: a prospective study. Lancet 2003;361:1767–72.
[13] Hu Y, Sun J, Dai Z, et al. Prevalence and severity of corona virus disease 2019 (COVID-19): a systematic review and meta-analysis. J Clin Virol 2020;127:104371.

[14] Yang J, Zheng Y, Gou X, et al. Prevalence of comorbidities and its effects in coronavirus disease 2019 patients: a systematic review and meta-analysis. Int J Infect Dis 2020;94:91–5.
[15] Odegaard JI, Chawla A. Connecting type 1 and type 2 diabetes through innate immunity. Cold Spring Harb Perspect Med 2012;2:a007724.
[16] Dooley KE, Chaisson RE. Tuberculosis and diabetes mellitus: convergence of two epidemics. Lancet Infect Dis 2009;9:737–46.
[17] Jella TK, Acuna AJ, Samuel LT, et al. Geospatial mapping of orthopaedic surgeons age 60 and over and confirmed cases of COVID-19. J Bone Joint Surg Am 2020.
[18] Dhingra R, Vasan RS. Age as a risk factor. Med Clin North Am 2012;96:87–91.
[19] Klugman KP. Risk factors for antibiotic resistance in Streptococcus pneumoniae. S Afr Med J 2007;97:1129–32.