Epidemiological and clinical characteristics of patients with COVID-19 from a designated hospital in Hangzhou City: a retrospective observational study

J Gao, S Zhang *, K Zhou, X Zhao, J Liu, Z Pu

ABSTRACT

Introduction: The outbreak of coronavirus disease 2019 (COVID-19) has exerted a heavy burden on public health worldwide. We aimed to investigate the epidemiological and clinical characteristics of patients with COVID-19 in a designated hospital in Hangzhou, China.

Methods: This was a retrospective study that included laboratory-confirmed cases of COVID-19 in XiXi Hospital of Hangzhou from 15 January 2020 to 30 March 2020. We reviewed and analysed the epidemiological, demographic, clinical, radiological, and laboratory features involving these cases. Age-stratification analysis was also implemented.

Results: We analysed 96 confirmed cases. The patients had a mean age of 43 years, with six patients younger than 18 years and 14 patients older than 60 years. No significant gender difference was discovered. Co-morbidities were commonly observed in patients aged over 40 years. Twenty eight of the patients had travelled from Wuhan City, and 51 patients were infected through close contact. Familial clusters accounted for 48 of the cases. The mean incubation time was 7 days, and the symptoms were mainly fever, cough, fatigue, and sore throat. Lymphocytopenia was observed predominantly in patients aged over 60 years. Fifty five patients presented with bilateral pulmonary lesions. The radiological changes were typically distributed in the subpleural area, and pleural effusion rarely occurred. All patients were discharged successfully.

Conclusion: During the early stage of the COVID-19 outbreak, half of the patients from a designated hospital in Hangzhou City were discovered as familial clusters. Therefore, strict prevention and control measures during self-isolation should be implemented. Patients aged over 60 years who had underlying co-morbidities were prone to lymphocytopenia and severe infection.

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New knowledge added by this study

- Half of the patients with coronavirus disease 2019 (COVID-19) from a designated hospital in Hangzhou City (outside of Hubei Province) during the early stage of COVID-19 outbreak were discovered as familial clusters.
- The patients with COVID-19 who were aged >60 years and had underlying co-morbidities were prone to lymphocytopenia and severe infection.
- All patients with COVID-19 in our centre successfully recovered and were eventually discharged.

Implications for clinical practice or policy

- Strict prevention and control measures should be implemented to prevent intrafamilial dissemination of severe acute respiratory syndrome coronavirus 2 during self-isolation and home quarantine, a meaningful insight for policy makers.
- Patients aged >60 years with COVID-19 should be cared for and treated more carefully.
- In general, patients with COVID-19 can recover well when diagnosed and treated early and properly, if overcrowding of medical resources is avoided.

Introduction

The rapid spread of coronavirus disease 2019 (COVID-19) has become a focus of public health concern since November 2019. According to the World Health Organization report with data updated on 6 November 2020, the COVID-19 pandemic has caused over 48.5 million confirmed cases and over 1.23 million deaths worldwide.[1] The 2019 novel

中國杭州市定點醫院的新冠肺炎患者的流行病學和臨床特徵：回顧性調查研究

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引言：新冠肺炎爆發給全球公共衛生資源帶來沉重的負擔。本研究旨在分析中國杭州市一所定點醫院的新冠肺炎患者的流行病學和臨床特徵。

方法：這項回顧性研究納入2020年1月15日至3月30日期間於杭州西溪醫院經實驗室確診的新冠肺炎患者，回顧分析他們的流行病學、人口學、臨床、影像學及實驗室特徵，並進行年齡分層分析。

結果：本研究共分析96名確診患者。患者平均年齡43歲，6名小於18歲，14名大於60歲。性別之間無差異。40歲以上成年人常有伴存疾病。28名患者來源於武漢，51名因密切接觸而感染。48名患者存在家庭聚集發病特徵。所有患者平均潛伏期為7天，以發熱、咳嗽、乏力、咽痛等為主要臨床表現。就診時血液淋巴細胞數減少常見於60歲以上人群。55名患者存在雙側肺部病灶，影像學檢查顯示常見於胸膜下，但胸腔積液罕見。所有患者均康復出院

結論：研究顯示在新冠肺炎爆發初期，本院患者中佔一半因家庭聚集發病。因此，對自我隔離的患者應採取嚴格的預防及控制措施。有伴存疾病的60歲以上患者較易引致血液淋巴細胞數減少和進展為重症。

coronavirus has been designated as severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) by the Coronavirus Study Group of the International Committee on Taxonomy of Viruses. The Law on Prevention and Control of Infectious Diseases, China categorises COVID-19 as a Category B infectious disease, but it is supervised as Category A in China.

During the early stage of the COVID-19 outbreak, especially before the lockdowns of Wuhan City and then Hubei Province, some people who had been infected by the virus travelled back to Hangzhou from Wuhan. Then the disease was disseminated by person-to-person transmission within the Hangzhou community. A familial cluster of the disease occurred during the self-isolation and home quarantine period because of intrafamilial transmission. The XiXi Hospital of Hangzhou was immediately designated by the government as the only municipal hospital for diagnosis and therapy of patients with COVID-19 in Hangzhou City. We reviewed and analysed the hospital's medical records to determine the epidemiological and clinical characteristics of these cases.

Methods

Participants and setting

This retrospective observational study was performed on the records of patients who were treated from 15 January 2020 to 30 March 2020 at the XiXi Hospital of Hangzhou. The study adhered to the ethical principles of medical research involving human subjects of the World Medical Association Declaration of Helsinki and was approved by the Ethics Committee of the XiXi Hospital of Hangzhou. Informed consent was waived because of the retrospective nature of this study.

Instruments and testing

The following instruments and materials were used in the study: a blood gas analyser (Radiometer ABL90, Denmark), an automatic haematology analyser (SYSMEX XE-5000, Japan), an automatic coagulation analyser (SYSMEX CS5100, Japan), an automatic biochemistry analyser (Beckman Coulter AU5831, US), and a vacuum blood collection tube (BD Vacutainer containing lithium heparin anticoagulant, US). Body surface temperature was detected by a non-contact infrared thermometer (JXB-178, Berrcom, Guangzhou). A fever was defined as a body temperature >37.0°C. Chest computed tomography (CT) scans (GE Revolution EVO, US) were conducted on every patient. Standard nucleic acid detection for SARS-CoV-2 was conducted at the Hangzhou Municipal Center for Disease Control and Prevention by the way of qualitative polymerase chain reaction (PCR). The diagnostic criteria were based on the recommendation of the National Institute for Viral Disease Control and Prevention, China (http://ivdc.chinacdc.cn/kyjz/202001/t20200121_211337.html).

Data collection

Epidemiological and demographic information about patients with COVID-19 was collected and reviewed, including age, gender, height, weight, co-morbidities like hypertension and type 2 diabetes mellitus, history of smoking, drinking and surgery, and recent travel and residence history. The clinical features and symptoms were recorded and reviewed during hospital visits. The results of the first laboratory tests performed on hospital admission were analysed. During hospitalisation, clinical and laboratory characteristics including SARS-CoV-2 nucleic acid test results were evaluated. Radiological manifestations on chest CT scan were examined. The outcomes of treatment were checked, and the patients received follow-up.

Two attending doctors were responsible for the diagnosis and treatment of all patients with COVID-19 according to the clinical diagnosis guideline and treatment protocol for COVID-19 released by the National Health Commission & National Administration of Traditional Chinese Medicine, China and the Zhongnan Hospital of Wuhan University Novel Coronavirus Management and Research Team.[2,3] The radiological diagnosis of chest CT scans was decided by two attending radiologists and another two attending clinical doctors independently.

Severity classification

The laboratory-confirmed cases were classified according to severity as mild (ie, mild symptoms without pneumonia), moderate (ie, respiratory symptoms and fever with pneumonia), severe (ie, respiratory distress, respiratory frequency ≥30/min, blood oxygen saturation ≤93%, ratio of partial pressure of arterial oxygen to fraction of inspired oxygen <300 mm Hg, and/or lung infiltration >50% within 24-48 hours), and critical (ie, respiratory failure, shock, and/or multiple organ dysfunction or failure).

Discharge criteria

The discharge criteria were normalisation of body temperature for more than 3 days, obvious improvement of respiratory symptoms, pulmonary imaging showing distinct inflammation absorption, and two consecutive negative nucleic acid tests on respiratory tract samples such as sputum or nasopharyngeal swab (with a sampling interval of at least 24 hours). Patients with COVID-19 who met the above criteria could be discharged.

Statistical analysis

We used SPSS (Windows version 19.0; IBM Corp, Armonk [NY], US) for all statistical analyses. One-way analysis of variance was performed to compare continuous, normally distributed numeric variables, which were presented as means and 95% confidence intervals. The Mann-Whitney *U* non-parametric test was used to compare continuous numeric variables with skewed distributions, which were shown as medians and 95% confidence intervals. The Pearson χ^2 test was employed to compare categorical variables, which were presented as frequencies and proportions (percentages). A stratified analysis by age was also conducted. Comparative analysis between early and late discharge was implemented to explore potentially associated factors. A P value of <0.05 was considered to be statistically significant.

Results

Epidemiological, demographic, and general clinical characteristics

Among these 96 patients with COVID-19, six were aged 0 to 18 years and 14 were aged >60 years (Table 1). Most (79.2%) patients were aged between 19 and 60 years. No significant sex difference was discovered. All patients had basically normal body mass index values. Half of patients aged >60 years had a history of hypertension. Eight adult patients

TABLE 1. General characteristics of the patients with COVID-19*

	Total (n=96)	Age-group (years)				P value‡
		0-18 (n=6)	19-39 (n=36)	40-60 (n=40)	>60 (n=14)	
Age (years)	43.0 (40.0-46.6)	8.7 (3.5-13.8)	31.8 (30.1-33.5)	49.5 (47.4-51.6)	67.9 (62.8-73.0)	NC
Male sex	44 (45.8%)	2 (33.3%)	17 (47.2%)	17 (42.5%)	8 (57.1%)	0.728
Smoking	9 (9.4%)	0	3 (8.3%)	5 (12.5%)	1 (7.1%)	0.751
Drinking	10 (10.4%)	0	4 (11.1%)	5 (12.5%)	1 (7.1%)	0.786
Hypertension	16 (16.7%)	0	1 (2.8%)†	8 (20.0%)	7 (50.0%)†	0.001
Surgical history	8 (8.3%)	0	1 (2.8%)	5 (12.5%)	2 (14.3%)	0.313
Travel from Wuhan	28 (29.2%)	4 (66.7%)	10 (27.8%)	12 (30.0%)	2 (14.3%)	0.131
Close contact	51 (53.1%)	2 (33.3%)	21 (58.3%)	20 (50.0%)	8 (57.1%)	0.663
Family cluster	48 (50.0%)	5 (83.3%)	15 (41.7%)	19 (47.5%)	9 (64.3%)	0.179
Weight (kg)	60.8 (58.2-63.4)	36.2 (16.6-55.7)	61.4 (57.4-65.4)	63.7 (59.9-67.5)	62.1 (56.2-68.0)	NC
Height (cm)	163.7 (161.1-166.0)	134.7 (106.1-163.2)	168.5 (166.0-171.0)	163.6 (161.5-165.8)	164.5 (161.4-167.5)	NC
BMI (kg/cm^2)	22.4 (21.8-23.1)	18.6 (15.1-22.0)†	21.5 (20.5-22.5)	23.7 (22.6-24.8)†	22.9 (21.2-24.5)	0.001
$D_{O\text{-}T\text{-}V}$ (days)	3.7 (3.0-4.4)	4.2 (1.0-7.4)	3.5 (2.4-4.5)	3.9 (2.5-5.2)	3.6 (1.7-5.5)	0.954
$D_{O\text{-}T\text{-}A}$ (days)	4.5 (3.9-5.3)	4.3 (1.3-7.4)	4.6 (3.4-5.7)	4.5 (3.3-5.8)	4.5 (2.0-7.1)	0.999
$D_{O\text{-}T\text{-}P}$ (days)	5.2 (4.5-6.0)	5.0 (2.4-7.7)	5.6 (4.3-6.8)	5.0 (3.7-6.2)	5.0 (2.6-7.4)	0.908
$D_{Incubation}$ (days)	7.0 (5.8-8.3)	6.0 (1.7-10.3)	7.2 (5.1-9.3)	5.9 (4.5-7.3)	11.1 (2.6-19.7)	0.147
$D_{F\text{-}B\text{-}A}$ (days)	3.3 (2.6-4.1)	4.5 (0.0-9.3)	3.6 (2.2-5.0)	3.4 (2.1-4.6)	2.2 (1.0-3.4)	0.537
$T_{Max\text{-}B\text{-}A}$ (°C)	37.9 (37.8-38.1)	37.7 (37.1-38.3)	38.0 (37.7-38.3)	38.0 (37.7-38.2)	37.7 (37.3-38.1)	0.569

Abbreviations: BMI = body mass index; COVID-19 = coronavirus disease 2019; $D_{F\text{-}B\text{-}A}$ = days with a fever before hospital admission; $D_{Incubation}$ = viral incubation days; $D_{O\text{-}T\text{-}A}$ = days from symptom onset to hospital admission; $D_{O\text{-}T\text{-}P}$ = days from symptom onset to definitive diagnosis based on positive viral nucleic acid test; $D_{O\text{-}T\text{-}V}$ = days from symptom onset to hospital visit; NC = not calculated; $T_{Max\text{-}B\text{-}A}$ = maximum body temperature before hospital admission

* Data are shown as mean (95% confidence interval) or No. (%), unless otherwise specified

† Between-group statistical significance after age-stratification analysis

‡ P value denotes the results of general comparison among four groups after age-stratification analysis

had a surgical history involving pituitary tumour, pulmonary abscess, coronary artery bypass grafting because of coronary heart disease, gallbladder stone, ovarian cyst, Caesarean section, or splenectomy because of trauma. Other co-morbidities were exclusively observed in patients aged >40 years, including type 2 diabetes mellitus, fatty liver, hepatitis B, liver cirrhosis, and bronchiectasis. A history of smoking or drinking was reported by nine (9.4%) and 10 (10.4%) patients, respectively.

Among 96 patients with confirmed infection, 28 (29.2%) had travelled from Wuhan City, and 51 cases were acquired via close contact. However, a few patients had no definitive contact history, even after rigorous tracing. Familial clusters of the disease accounted for 48 of this study's cases, and 11 patients who had travelled from Wuhan City presented in familial clusters. In most familial clusters, two members were attacked, however, six family members were also found to be infected in two separate familial clusters.

The mean time from symptom onset to the first visit was 3.7 days, and the time to hospital admission was 4.5 days. The period from symptom onset to definitive diagnosis based on positive viral nucleic acid test was 5.2 days. The mean incubation time was 7.0 days. The mean time with fever before admission was 3.3 days, and the maximum body temperature before admission was 37.9°C.

Symptoms recorded during hospital visits

The laboratory-confirmed patients' main symptoms were fever, cough, fatigue, sore throat, chills, expectoration, shortness of breath, headache, dizziness, decreased appetite, diarrhoea, nausea, and vomiting (Table 2). These symptoms essentially involved the respiratory system, in addition to the alimentary and central nervous systems. The symptoms were basically similar across different age-groups, except that shortness of breath occurred more commonly among patients aged >60 years.

First test results on hospital admission

As presented in Table 3, the mean white blood cell count was not elevated. Besides white blood cells, the levels of haemoglobin, eosinophil, and platelets were basically within normal ranges. Lymphocytopenia was observed predominantly in patients aged >60 years. The concentrations of blood electrolytes, glucose, lactate, triglycerides, and free fatty acids were largely normal. Injury to the liver, kidney, heart, and coagulation systems were not observed. Further, hypoxaemia was not found in most cases on

TABLE 2. Symptoms of the patients with COVID-19 during hospital visits*

	Total (n=96)	Age-group (years)				P value§
		0-18 (n=6)	19-39 (n=36)	40-60 (n=40)	>60 (n=14)	
Fever	77 (80.2%)	4 (66.7%)	30 (83.3%)	33 (82.5%)	10 (71.4%)	0.631
Cough	55 (57.3%)	3 (50.0%)	23 (63.9%)	23 (57.5%)	6 (42.9%)	0.580
Fatigue	24 (25.0%)	1 (16.7%)	8 (22.2%)	11 (27.5%)	4 (28.6%)	0.897
Sore throat	21 (21.9%)	0	10 (27.8%)	8 (20.0%)	3 (21.4%)	0.476
Chills	16 (16.7%)	1 (16.7%)	8 (22.2%)	6 (15.0%)	1 (7.1%)	0.616
Expectoration	16 (16.7%)	1 (16.7%)	5 (13.9%)	9 (22.5%)	1 (7.1%)	0.553
Lack of appetite	16 (16.7%)	0	7 (19.4%)	6 (15.0%)	3 (21.4%)	0.506
Headache	15 (15.6%)	1 (16.7%)	7 (19.4%)	6 (15.0%)	1 (7.1%)	0.758
Shortness of breath	14 (14.6%)	1 (16.7%)	3 (8.3%)†	4 (10.0%)‡	6 (42.9%)†‡	0.013
Dizziness	13 (13.5%)	0	6 (16.7%)	4 (10.0%)	3 (21.4%)	0.491
Chest distress	9 (9.4%)	0	2 (5.6%)	6 (15.0%)	1 (7.1%)	0.422
Diarrhoea	9 (9.4%)	1 (16.7%)	4 (11.1%)	4 (10.0%)	0	0.579
Backache	8 (8.3%)	0	4 (11.1%)	4 (10.0%)	0	0.507
Anosmia	7 (7.3%)	2 (33.3%)	2 (5.6%)	3 (7.5%)	0	0.063
Runny nose	7 (7.3%)	1 (16.7%)	4 (11.1%)	2 (5.0%)	0	0.396
Nausea and vomiting	5 (5.2%)	0	3 (8.3%)	1 (2.5%)	1 (7.1%)	0.628
Chest pain	4 (4.2%)	0	0	3 (7.5%)	1 (7.1%)	0.355
Palpitations	2 (2.1%)	0	0	2 (5.0%)	0	0.414

Abbreviation: COVID-19 = coronavirus disease 2019

* Data are shown as No. (%), unless otherwise specified

† ‡ Between-group statistical significance after age-stratification analysis

§ P value denotes the results of general comparison among four groups after age-stratification analysis

TABLE 3. Initial test results of the patients with COVID-19 on hospital admission

	Total (n=96)	Age-group (years)				P value‖
		0-18 (n=6)	19-39 (n=36)	40-60 (n=40)	>60 (n=14)	
T (36.0-37.0°C)	37.1 (36.9-37.2)	36.8 (35.9-37.7)	37.1 (36.9-37.3)	37.1 (36.9-37.2)	37.1 (36.6-37.5)	0.826
WBC (3.5-9.5×10⁹/L)	5.9 (5.4-6.4)	8.2 (3.6-12.7)	5.7 (5.0-6.5)	5.9 (5.1-6.8)	5.3 (4.1-6.4)	0.119
Hb (130-175 g/L)	136.8 (132.9-140.3)	134.0 (120.7-147.3)	140.7 (134.5-146.8)	136.2 (129.6-142.8)	129.5 (121.3-137.7)	0.273
Lym (1.1-3.2×10⁹/L)	1.5 (1.3-1.6)	3.2 (2.1-4.3)†‡§	1.5 (1.3-1.6)†	1.4 (1.1-1.6)‡	0.9 (0.6-1.2)§	0.000
Eo (0.02-0.52×10⁹/L)	0.05 (0.03-0.08)	0.30 (0.06-0.55)†‡§	0.06 (0.02-0.09)†	0.03 (0.01-0.04)‡	0.02 (0.00-0.05)§	0.000
Plt (125-350×10⁹/L)	214.4 (199.9-229.6)	326.3 (245.4-407.3)†‡	205.4 (184.8-226.0)†	214.0 (189.7-238.3)	190.4 (155.8-224.9)‡	0.001
P/F (400-500 mm Hg)	340.2 (332.4-348.3)	332.7 (304.8-360.5)	351.4 (340.0-362.7)	338.1 (325.9-350.2)	320.9 (291.5-350.2)	0.076
Lac (0.7-2.1 mmol/L)	1.6 (1.5-1.8)	2.0 (1.0-2.9)	1.6 (1.4-1.8)	1.6 (1.4-1.7)	1.8 (1.3-2.3)	0.398
K (3.5-5.3 mmol/L)	3.8 (3.7-3.9)	4.42 (4.11-4.74)†	3.81 (3.68-3.93)	3.68 (3.56-3.79)†	3.82 (3.49-4.14)	0.001
Na (137-147 mmol/L)	137.3 (136.7-137.8)	137.4 (135.9-138.8)	137.5 (136.9-138.2)	137.7 (136.8-138.6)	135.3 (132.4-138.2)	0.054
Cl (99-110 mmol/L)	102.4 (101.8-102.9)	102.5 (100.5-104.4)	102.4 (101.5-103.3)	102.9 (102.0-103.8)	100.6 (98.0-103.3)	0.133
Glu (3.9-6.1 mmol/L)	6.9 (6.5-7.4)	5.1 (4.5-5.8)†	6.3 (5.8-6.9)‡	7.1 (6.5-7.8)	8.6 (6.6-10.7)†‡	0.002
Cr (57-111 μmol/L)	63.4 (59.6-67.6)	40.5 (27.0-54.0)†‡	64.9 (57.5-72.3)†	62.1 (57.1-67.1)	73.4 (61.2-85.5)‡	0.006
BUN (3.6-9.5 mmol/L)	4.2 (3.9-4.6)	4.1 (3.1-5.1)	3.7 (3.3-4.0)†	4.2 (3.8-4.6)‡	5.8 (4.3-7.3)†‡	0.000
ALT (9-50 U/L)	29.2 (23.1-36.8)	12.8 (7.8-17.9)	29.2 (17.7-40.7)	34.4 (22.3-46.5)	21.8 (16.3-27.3)	0.361
AST (15-40 U/L)	28.0 (25.2-30.9)	26.5 (17.7-35.3)	25.6 (20.6-30.6)	30.5 (25.5-35.5)	27.8 (24.2-31.4)	0.486
γ-GT (10-60 U/L)	32.2 (25.4-41.5)	11.7 (9.3-14.0)	27.0 (19.4-34.6)	41.0 (23.7-58.2)	29.1 (20.3-37.9)	0.210
LDH (120-250 U/L)	272.8 (243.9-305.1)	306.8 (85.6-528.1)	238.6 (191.3-285.9)	287.9 (232.0-343.7)	308.2 (213.4-403.1)	0.396
tBil (3.42-20.52 μmol/L)	12.59 (10.86-14.27)	6.57 (1.96-11.18)	15.46 (12.28-18.65)	10.49 (8.23-12.74)	13.77 (8.15-19.38)	0.056
Alb (44.0-55.0 g/L)	40.4 (39.4-41.4)	43.3 (38.8-47.8)†	42.8 (41.5-44.2)‡§	39.0 (37.7-40.3)‡	36.9 (33.9-39.9)†§	0.000
FFA (129-769 μmol/L)	369.8 (315.8-429.2)	321.5 (0.0-668.2)	363.6 (252.4-474.8)	359.2 (267.2-451.1)	417.2 (296.3-538.1)	0.854
TG (0.52-1.7 mmol/L)	1.35 (1.19-1.52)	1.16 (0.54-1.79)	1.27 (0.98-1.57)	1.48 (1.16-1.79)	1.22 (0.93-1.51)	0.644
CK (24-194 U/L)	96.5 (73.6-126.5)	65.2 (39.5-90.8)	75.5 (53.8-97.3)	116.9 (51.3-182.5)	105.9 (77.8-133.9)	0.575
CK-MB (0-25 U/L)	11.9 (10.7-13.1)	16.7 (8.9-24.5)	11.1 (8.5-13.6)	11.7 (10.2-13.3)	12.3 (9.6-15.0)	0.221
TNI (0.0-0.04 ng/mL)	0.01 (0.01-0.01)	0.01 (0.01-0.01)	0.01 (0.01-0.01)	0.01 (0.01-0.01)	0.01 (0.00-0.02)	0.999
TNT (0.0-0.13 ng/mL)	0.01 (0.00-0.01)	0.00 (0.00-0.03)	0.00 (0.00-0.01)	0.01 (0.00-0.01)	0.01 (0.00-0.01)	0.435
BNP (0-100 pg/mL)	96.8 (49.3-165.7)	46.0 (0.0-96.8)	25.4 (19.0-31.9)	83.8 (33.7-133.9)	253.5 (0.0-561.5)	0.051
PT (9.7-13.5 s)	12.0 (11.8-12.2)	11.6 (10.8-12.5)	12.1 (11.9-12.4)	11.8 (11.6-12.1)	12.2 (11.6-12.7)	0.223
APTT (23.0-32.6 s)	30.1 (29.5-30.8)	29.3 (26.7-31.8)	30.4 (29.4-31.4)	29.6 (28.6-30.6)	31.3 (29.3-33.3)	0.286
FG (1.8-3.5 g/L)	3.26 (3.01-3.52)	2.62 (1.74-3.50)	3.04 (2.59-3.49)	3.29 (2.95-3.63)	4.00 (3.36-4.63)	0.202
DDI (0.00-0.55 μg/mL)	0.39 (0.30-0.51)	0.48 (0.00-0.99)	0.26 (0.16-0.36)†	0.36 (0.24-0.47)‡	0.80 (0.23-1.36)†‡	0.007
CRP (0-10 mg/L)	16.2 (12.3-20.8)	4.8 (1.1-8.6)	12.9 (5.9-20.0)†	15.5 (10.4-20.6)	31.6 (14.9-48.2)†	0.012
PCT (0-0.5 ng/mL)	0.058 (0.036-0.098)	0.035 (0.028-0.043)	0.039 (0.027-0.052)	0.081 (0.000-0.163)	0.048 (0.037-0.058)	0.695
SAA (0-10 mg/L)	61.7 (51.9-72.0)	31.8 (0.0-81.1)	42.7 (25.7-59.7)†	73.8 (57.9-89.8)	88.1 (60.6-115.5)†	0.005

Abbreviations: Alb = albumin; ALT = alanine aminotransferase; APTT = activated partial thromboplastin time; AST = aspartate aminotransferase; BNP = brain natriuretic peptide; BUN = blood urea nitrogen; CK = creatine kinase; CK-MB = creatine kinase-MB isoenzyme; Cl = chlorine; COVID-19 = coronavirus disease 2019; Cr = creatinine; CRP = C-reactive protein; DDI = D-dimer; Eo = eosinophil; FFA = free fatty acid; FG = fibrinogen; Glu = glucose; Hb = haemoglobin; K = potassium; Lac = lactate; LDH = lactate dehydrogenase; Lym = lymphocyte count; Na = sodium; P/F = ratio of PaO2/FiO2; PCT = procalcitonin; Plt = platelet; PT = prothrombin time; SAA = serum amyloid A; T = temperature of body surface; tBil = total bilirubin; TG = triglyceride; TNI = troponin I; TNT = troponin T; WBC = white blood cells; γ-GT = γ-glutamyltransferase

* Data are shown as mean (95% confidence interval)

† ‡ § Between-group statistical significance after age-stratification analysis

‖ P value denotes the results of general comparison among four groups after age-stratification analysis

hospital admission, except for several patients aged >60 years. The overall ratio of the partial pressure of arterial oxygen to the fraction of inspired oxygen was about 340 mm Hg. Inflammatory biomarkers are an acute-phase response to the virus insult and are therefore involved in the development of the disease.

Generally, the level of blood C-reactive protein was slightly elevated on admission (16.2 mg/L), and that of patients aged >60 years was relatively higher (31.6 mg/L). Serum amyloid A concentration increased in almost all cases (61.7 mg/L), especially for patients aged >60 years (88.1 mg/L). The procalcitonin level did not increase across all cases on admission.

Features during hospitalisation

During hospitalisation, eight patients with COVID-19 were transferred to a designated provincial hospital in Hangzhou to enact an optimal allocation policy. Therefore, we analysed the clinical and laboratory features of 88 cases during hospitalisation (Table 4). The severity of disease was mild or moderate in 83 patients (around 94%). Among 12 patients aged >60 years, three (25%) had severe disease. The mean length of stay across all cases was 15.6 days. The mean time with fever during hospitalisation was 4.4 days. The mean maximum body temperature was 37.8°C. Hypokalaemia, hyponatraemia, and hypoalbuminaemia were more likely to develop in patients aged >60 years. The time from symptom onset to secondary negative result of a viral nucleic acid test was about 17 days, and the mean time to patient discharge was about 20 days.

Most cases (59.1%) were supported through

TABLE 4. Features of the patients with COVID-19 during hospitalisation*

	Total (n=88)	Age-group (years)				P value¶
		0-18 (n=6)	19-39 (n=34)	40-60 (n=36)	>60 (n=12)	
Disease severity						
Mild	14 (15.9%)	3 (50%)	5 (14.7%)	5 (13.9%)	1 (8.3%)	0.118
Moderate	69 (78.4%)	3 (50%)	28 (82.4%)	30 (83.3%)	8 (66.7%)	0.198
Severe	5 (5.7%)	0†	1 (2.9%)	1 (2.8%)	3 (25.0%)†	0.021
LOS	15.6 (14.4-16.9)	14.3 (2.2-26.4)	15.3 (13.2-17.3)	16.3 (14.4-18.2)	15.3 (12.1-18.4)	0.844
≤10 Days	20 (22.7%)	4 (66.7%)	6 (17.6%)	8 (22.2%)	2 (16.7%)	0.061
>10 Days	68 (77.3%)	2 (33.3%)	28 (82.4%)	28 (77.8%)	10 (83.3%)	0.061
T_{max} (°C)	37.8 (37.6-37.9)	37.5 (36.7-38.4)	37.6 (37.3-37.8)	37.9 (37.6-38.1)	38.1 (37.7-38.6)	0.076
D_{fever} (days)	4.4 (3.4-5.5)	3.0 (0.0-7.9)	3.9 (2.0-5.7)	4.7 (3.1-6.4)	5.1 (1.7-8.5)	0.756
D_{lac} (days)	6.1 (4.9-7.4)	0.8 (0.0-2.4)	6.3 (3.8-8.9)	6.5 (4.4-8.6)	6.8 (3.7-10.0)	0.245
K_{min} (mmol/L)	3.4 (3.3-3.5)	4.1 (3.8-4.5)†‡§	3.5 (3.4-3.6)†	3.3 (3.2-3.4)‡	3.3 (3.1-3.5)§	0.000
Na_{min} (mmol/L)	135.2 (134.8-135.6)	136.9 (135.5-138.3)†	135.9 (135.3-136.4)‡	134.8 (134.1-135.5)	133.6 (131.8-135.4)†‡	0.001
Alb_{min} (g/L)	36.4 (35.3-37.4)	42.3 (37.6-46.9)†‡	38.7 (37.1-40.3)§‖	34.9 (33.7-36.0)†§	33.4 (30.1-36.6)‡‖	0.000
D_{O-T-N} (days)	17.3 (15.9-18.8)	13.2 (9.3-17.1)	17.9 (15.1-20.6)	18.0 (15.9-20.1)	16.1 (11.4-20.7)	0.386
D_{O-T-D} (days)	20.4 (19.1-22.0)	20.0 (9.5-30.5)	20.7 (17.9-23.6)	20.5 (18.3-22.7)	19.6 (14.8-24.4)	0.975
Treatment						
Antivirals	88 (100%)	6 (100%)	34 (100%)	36 (100%)	12 (100%)	NC
Antibiotics	21 (23.9%)	1 (16.7%)	6 (17.6%)	9 (25.0%)	5 (41.7%)	0.390
Glucocorticoids	11 (12.5%)	0	2 (5.9%)	5 (13.9%)	4 (33.3%)	0.071
γ-Globulin	9 (10.2%)	0	3 (8.8%)	4 (11.1%)	2 (16.7%)	0.722
Oxygen support						
Nasal catheter	17 (19.3%)	1 (16.7%)	8 (23.5%)	5 (13.9%)	3 (25.0%)	0.719
Mask	35 (39.8%)	0	16 (47.1%)	15 (41.7%)	4 (33.3%)	0.173
MV	0	0	0	0	0	NC
Survival	88 (100%)	6 (100%)	34 (100%)	36 (100%)	12 (100%)	NC

Abbreviations: Alb_{min} = minimum level of blood albumin; COVID-19 = coronavirus disease 2019; D_{fever} = days of fever (>37.0°C of body surface temperature); D_{lac} = days of elevated blood lactate (>2.1 mmol/L); D_{O-T-D} = days from symptom onset to patient discharge; D_{O-T-N} = days from symptom onset to secondary negative result of viral nucleic acid test; K_{min} = minimum level of blood potassium; LOS = length of stay; MV = mechanical ventilation; Na_{min} = minimum level of blood sodium; NC = not calculated; T_{max} = maximum body temperature

* Data are shown as No. (%) or mean (95% confidence interval), unless otherwise specified. Eight patients with COVID-19 were transferred to a designated provincial hospital during hospitalisation to enact an optimal allocation policy. Therefore, they were excluded from analysis during this step

† ‡ § ‖ Between-group statistical significance after age-stratification analysis

¶ P value denotes the results of general comparison among four groups after age-stratification analysis

nasal catheter or mask oxygen. No one was assisted by non-invasive or invasive mechanical ventilation. All patients were treated with one or two kinds of antivirals, ie, α-interferon, lopinavir/ritonavir, or abidor. Antibiotics like levofloxacin and moxifloxacin were prescribed when bacterial infection was suspected. Adjuvant therapy with glucocorticoids (methylprednisolone, 40-80 mg/d) or γ-globulin was implemented only in a small percentage of cases (around 10%) and exclusively in adult patients. All patients successfully recovered and were discharged. No one progressed to the critically ill state, and the absence of recurrence in all cases was confirmed by follow-up until 20 June 2020.

Radiological manifestations during hospitalisation

Radiological pulmonary imaging was evaluated during hospitalisation of the patients with moderate and severe disease (74 cases) [Table 5 and Fig]. A total of 19 (25.7%) and 55 (74.3%) patients presented with unilateral and bilateral pulmonary lesions, respectively. Ground-glass opacities in the lungs were discovered on chest CT scan in approximately 50% of cases. Radiological pulmonary changes were mostly distributed in the subpleural area (around 80%), and pleural effusion rarely occurred in any age-stratified group. The mean time from symptom onset to the worst CT imaging finding was 9 days, and the mean time to the start of pulmonary infiltration absorption on CT imaging was about 12 days.

Potential factors associated with early discharge

We explored the factors that could potentially be associated with early discharge of patients with COVID-19 (Table 6). Early discharge was defined as a hospital length of stay (LOS) of ≤10 days. A comparison was conducted between early (LOS ≤10 days) and late (LOS >10 days) discharge of patients with COVID-19. Of the investigated patients, 20 cases were discharged early, whereas 68 cases underwent late discharge. We compared 13 factors between the two groups. Two factors were

TABLE 5. Radiological manifestations of the patients with COVID-19 on chest computed tomography during hospitalisation*

	Total (n=74)	Age-group (years)				P value†
		0-18 (n=3)	19-39 (n=29)	40-60 (n=31)	>60 (n=11)	
Lesion distribution						
Unilateral	19 (25.7%)	2 (66.7%)	10 (34.5%)	4 (12.9%)	3 (27.3%)	0.090
Bilateral	55 (74.3%)	1 (33.3%)	19 (65.5%)	27 (87.1%)	8 (72.7%)	0.090
GGO	38 (51.4%)	0	15 (51.7%)	17 (54.8%)	6 (54.5%)	0.339
Subpleural distribution	59 (79.7%)	2 (66.7%)	21 (72.4%)	26 (83.9%)	10 (90.9%)	0.483
Pleural effusion	1 (1.4%)	0	0	1 (3.2%)	0	0.704
$D_{O\text{-}T\text{-}W}$ (days)	9.0 (8.1-10.0)	7.0 (0.0-16.0)	9.1 (7.3-10.9)	9.1 (7.7-10.6)	8.9 (5.5-12.3)	0.883
$D_{O\text{-}T\text{-}A\text{-}S}$ (days)	11.7 (10.6-13.0)	10.0 (0.0-21.4)	11.3 (9.3-13.2)	12.0 (10.2-13.8)	12.7 (7.7-17.7)	0.821

Abbreviations: COVID-19 = coronavirus disease 2019; $D_{O\text{-}T\text{-}A\text{-}S}$ = days from symptom onset to the start of pulmonary infiltration absorption on computed tomography imaging; $D_{O\text{-}T\text{-}W}$ = days from symptom onset to the worst finding on computed tomography imaging; GGO = ground-glass opacity

* Data are shown as No. (%) or mean (95% confidence interval), unless otherwise specified. Eight patients with COVID-19 were transferred to a designated provincial hospital during hospitalisation to enact an optimal allocation policy. Therefore, they were excluded from analysis during this step. There were no radiological findings of pneumonia among the 14 mild cases

† P value denotes the results of general comparison among four groups after age-stratification analysis

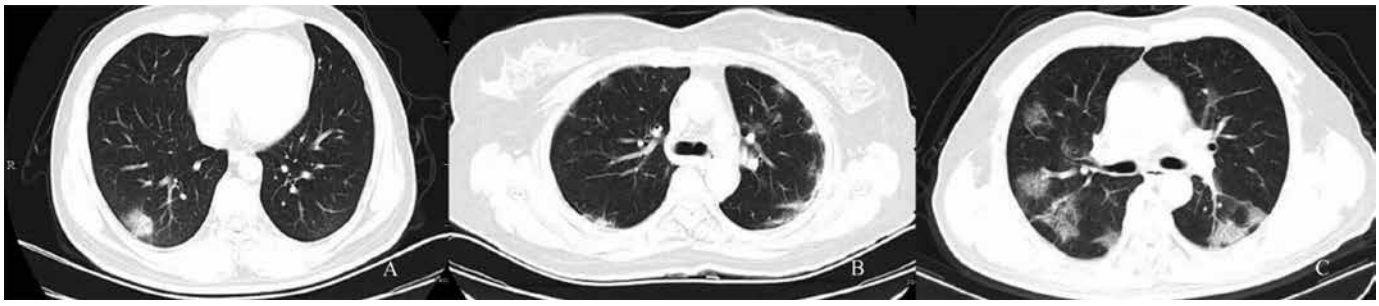

FIG. (a) Unilateral and (b) bilateral pulmonary lesions, and (c) ground-glass opacity found on chest computed tomography imaging

TABLE 6. Comparison between early and late discharge of the patients with COVID-19*

	Total (n=88)	LOS ≤10 days (n=20)	LOS >10 days (n=68)	P value
Age (years)	42.4 (38.9-45.9)	38.3 (30.0-46.6)	43.6 (39.7-47.5)	0.209
Smoking	9 (10.2%)	2 (10.0%)	7 (10.3%)	1.000
Hypertension	13 (14.8%)	4 (20.0%)	9 (13.2%)	0.696
Surgical history	6 (6.8%)	0	6 (8.8%)	0.383
Travel from Wuhan	25 (28.4%)	10 (50.0%)†	15 (22.1%)†	0.015
Close contact	49 (55.7%)	9 (45.0%)	40 (58.8%)	0.274
Lym ($\times 10^9$/L)	1.49 (1.32-1.66)	1.58 (1.16-2.00)	1.46 (1.27-1.66)	0.576
CRP (mg/L)	14.7 (10.7-18.8)	10.4 (5.8-15.0)	16.0 (11.0-21.1)	0.481
SAA (mg/L)	58.8 (47.6-69.9)	62.9 (32.2-93.6)	57.8 (45.7-69.9)	0.721
$D_{O\text{-}T\text{-}V}$ (days)	3.4 (2.7-4.0)	3.4 (2.1-4.8)	3.3 (2.6-4.1)	0.470
$D_{O\text{-}T\text{-}P}$ (days)	4.9 (4.1-5.6)	4.6 (3.0-6.1)	4.9 (4.1-5.8)	0.864
$D_{O\text{-}T\text{-}N}$ (days)	17.3 (15.9-18.8)	11.8 (9.8-13.7)†	18.7 (17.1-20.4)†	0.000
$D_{O\text{-}T\text{-}W}$ (days)	9.0 (8.0-10.0)	7.9 (5.6-10.3)	9.3 (8.1-10.4)	0.323

Abbreviations: COVID-19 = coronavirus disease 2019; CRP = C-reactive protein; $D_{O\text{-}T\text{-}N}$ = days from symptom onset to secondary negative result of viral nucleic acid test; $D_{O\text{-}T\text{-}P}$ = days from symptom onset to definitive diagnosis based on positive viral nucleic acid test; $D_{O\text{-}T\text{-}V}$ = days from symptom onset to hospital visit; $D_{O\text{-}T\text{-}W}$ = days from symptom onset to the worst finding on computed tomography imaging; LOS = length of stay; Lym = lymphocyte count; SAA = serum amyloid A

* Data are shown as mean (95% confidence interval) or No. (%), unless otherwise specified. Eight patients with COVID-19 were transferred to a designated provincial hospital during hospitalisation to enact an optimal allocation policy. Therefore, they were excluded from analysis during this step

† Between-group statistical significance after analysis

significantly associated with early discharge: more patients in the early discharge group compared with the late discharge group had travelled from Wuhan City (50.0% vs 22.1%). Further, the time from symptom onset to secondary negative result of a viral nucleic acid test was shorter in the early discharge group than the late discharge group (11.8 days vs 18.7 days).

Discussion

The emergence and spread of COVID-19 has caused a new public health crisis to threaten the world. Patient zero of the disease is still unknown, although many of the initial cases in Wuhan City had exposure to the Huanan Seafood Wholesale Market in common.[4,5] A probable bat origin of SARS-CoV-2 has been considered.[6] Angiotensin-converting enzyme II has been reported to be the entry receptor on epithelial and endothelial cells within the lung, heart, kidney, and intestine.[6,7] As a highly contagious disease, COVID-19 is transmitted by inhalation or contact with infected droplets. On 23 January 2020, Wuhan City, as the epicentre of COVID-19 in China, was locked down to prevent the disease's spread. Before the lockdown, some infected people left Wuhan City for other cities outside Hubei Province. Then, extensive person-to-person transmission occurred.[8,9] Thanks to healthcare service providers, all hospitalised patients with COVID-19 in our research survived, recovered successfully, and then were eventually discharged. The findings of our observational study can provide help with decision making about public health policy involving COVID-19 prevention and therapy.

This retrospective study reports the epidemiological, demographic, clinical, laboratory, and radiological findings of patients with COVID-19 who were treated at a designated hospital in Hangzhou City. A comparative analysis according to age stratification was implemented. Deterioration was more probable in patients aged over 60 years with underlying co-morbidities. The finding is consistent with those of another previous report.[10] Deterioration could be associated with the ageing and dysfunction of organs, especially reduced immune function as lymphocytopenia. Severe acute respiratory syndrome coronavirus 2 can consume lymphocytes, which is probably an important cause of the proliferation and spread of the virus. Although we did not detect the plasma levels of pro-inflammatory mediators like tumour necrosis factor and interleukin, the cytokine storm has been previously reported to be associated with COVID-19 severity.[11]

Respiratory symptoms like fever, cough, sore throat, and shortness of breath were commonly the first presentations during hospital visits among the patients in the present study. The disease should be differentiated from influenza and common cold-

causing rhinovirus or parainfluenza virus infections. In the early stage of the pandemic, a policy of self-isolation and home quarantine was implemented. However, because of the high contagiousness of SARS-CoV-2, 50% (48 of 96) of the cases in our study appeared as familial clusters. Prior studies also reported the discoveries of case clusters within familial households.[12-14] The basic reproductive number (R0) has been revealed to be as high as 2.2 or even 5.7.[15,16] Therefore, strict control measures should be implemented to avoid intrafamilial dissemination during self-isolation and home quarantine.

The disease has very strong infectivity by human-to-human transmission, even during the incubation period. Based on the gradually increasing understanding of the disease's characteristics, the policy for personnel travelling from the epidemic area to Hangzhou City was changed from self-isolation and home quarantine to centralised compulsory isolation on 21 March 2020. Consequently, person-to-person transmission was effectively controlled. Therefore, strict quarantine has been confirmed to be the only effective intervention to decrease the contagion rate.

Early negative turning of the viral nucleic acid test was associated with early discharge of patients with COVID-19 in this study. This may imply early recovery of injured organs. A relatively high proportion of patients who travelled from Wuhan City were discharged early. Thus, SARS-CoV-2 could have mutated and evolved. More research is needed to clarify that whether its virulence has increased or decreased after its propagation through generations.

In this study, five (5.7%) patients had the severe disease type, but no patients died. In a summary report from Chinese Center for Disease Control and Prevention with data updated through 11 February 2020, 14% of 44 415 confirmed cases were classified as severe, and 5% were critical.[13] The overall case-fatality rate was 2.3% (1023 of 44 672 confirmed cases). In Italy, the corresponding rate was reported to be 7.2% (1625 deaths of 22 512 cases) based on data through 17 March 2020.[17] The case-fatality rate of COVID-19 is much lower than those of the prior SARS and Middle East Respiratory Syndrome, which were 9.6% and 34.4%, respectively.[13] However, because of the shortage of PCR test kits and the existence of false-negative PCR results, the actual number of cases in the population is unknown. Serological tests, when available, could be adopted widely in the future for COVID-19 diagnosis. Although the quantity of cases in this study is limited, overall recovery from the disease will proceed well when diagnosis and treatment are conducted early and properly, if overcrowding of medical resources is avoided.

Bilateral distribution of patchy shadows and ground-glass opacities in the subpleural area were the most frequently discovered radiological findings in the present study, and these are typical hallmarks of radiological pulmonary imaging in COVID-19.[18] Although multiple organs (eg, those of the respiratory, alimentary, genitourinary, and central nervous systems) can interact with SARS-CoV-2 owing to viraemia and the cytokine storm, the lungs are still the principal target of the virus. Generally, the pulmonary presentation is consistent with the clinical severity of COVID-19. Because there were no critical cases in our study, more severe chest imaging findings were not present (eg, entire lungs involved in exudation and consolidation). Certain critical patients in intensive care units with severe acute respiratory distress syndrome even need extracorporeal membrane oxygenation support.[19] In epidemic areas, chest CT could also be adopted as an early supplementary diagnostic tool.[20]

So far, there is no specifically proven antiviral treatment for COVID-19. The mainstay of therapy is optimised supportive care, including proper oxygen supply. The efficacy of antiviral drugs, including lopinavir/ritonavir, is still unknown.[21] The pharmacotherapies used in the present study, including antiviral and immunomodulating treatments, are only empirical and palliative. Further randomised clinical trials are urgently needed to determine the most effective evidence-based treatments.

The current study has several limitations. First, this is a retrospective study with data from a single centre. The number of included cases is relatively small. However, it is meaningful for the evaluation of characteristics of early cases outside of Wuhan City, especially for policy makers. Second, no potentially effective antiviral drugs can be proposed by the present study. Further basic and clinical research is required to elucidate effective and safe pharmacotherapies, as to date, no proven antiviral drugs are available. Third, asymptomatic infection of COVID-19 is currently an important issue. We do not have enough data to provide associated information. More studies are needed to provide diagnosis and differentiation of asymptomatic cases, particularly involving the serological and nucleic acid tests that have recently become available to the general population.

Conclusion

During the early stage of the COVID-19 outbreak, half of the patients from a designated hospital in Hangzhou City were discovered as familial clusters. Therefore, strict prevention and control measures should be implemented during self-isolation. Patients aged >60 years with underlying co-morbidities were prone to lymphocytopenia and severe infection.

Author contributions

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Critical revision of the manuscript for important intellectual content: S Zhang, K Zhou, X Zhao, J Liu.

All authors had full access to the data, contributed to the study, approved the final version for publication, and take responsibility for its accuracy and integrity.

Conflicts of interest

All authors have disclosed no conflicts of interest.

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Ethics approval

The study was approved by the Ethics Committee of the XiXi Hospital of Hangzhou, China (Ref 2020-31). The requirement for informed consent was waived because of the retrospective nature of this study.

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