Clinical Characteristics and Risk Factors of Poor Prognosis in 83 Cases of Coronavirus Disease 2019

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Objective Since December 2019, coronavirus disease 2019 (COVID-19) emerged in Wuhan city and rapidly spread throughout the world. The clinical characteristics of patients with COVID-19 have been reported, but risk factors for prognosis have not been well described.**Methods** A total of 83 patients with COVID-19 were included in this retrospective study. All cases were divided into severe and nonsevere groups according to the severity of the disease. The primary composite endpoint was admission to an intensive care unit (ICU), use of mechanical ventilation or high-flow oxygen, or death. We used univariable and multivariable logistic regression methods to explore the risk factors associated with the primary composite endpoint.**Results**The median age of patients was 46 years; a total of 48.2% of the patients were male. Of these patients, 17 were in the severe group (20.5%), and 66 were in the nonsevere group (79.5%).In the severe group, the proportions of basic diseases, including hypertension, diabetes, and malignant tumors, were significantly higher than those in the nonsevere group(all P<0.05), and patients in the severe group were significantly older than those in the nonsevere group (P<0.05).The primary composite endpoint occurred in 13(15.7%) patients, including 10(12.0%) who underwent mechanical ventilation, 3(3.6%) who were treated with high-flow oxygen, 5(6.0%) who were admitted to the ICU,and 5(6.0%) who died. Multivariable regression showed that an increase in high-sensitivity C-reactive protein (1.063,1.02-1.108;P=0.004) or having diabetes (735.985,7.111-8444.318;P=0.002) was an independent risk factor for COVID-19 patients with poor prognosis; however,higher hemoglobin was associated with lower odds of poor prognosis(0.912, 0.856-0.97;P=0.004).**Conclusion**More than 20% ofpatients with COVID-19 developed severe conditions with a poor prognosis. The potential risk factors of high-sensitivity C-reactive protein, diabetes andlow hemoglobin content could help clinicians identify COVID-19 patients with poor prognosis on admission.

Keywords: COVID-19, Clinical characteristics, Risk factors, Prognosis

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INTRODUCTION

Since December 2019, coronavirus disease 2019 (COVID-19) has begun to appear in Wuhan city, Hubei province, and has gradually spread to other provinces and all over the world[1]. According to the China CDC official website (http://www.chinacdc.cn/jkzt/crb/zl/szkb_11803/jszl_11809/202003/t20200313_214391.html), as of March 2020 At 24:00 on the 12th, China accumulatively diagnosed 80,813 COVID-19

patients in 2019, 147 existing suspected patients, a total of 64,111 cured, and a total of 3,176 deaths, of which Wuhan, Hubei Province, a total of 49,991 confirmed patients and 2,436 deaths. The Director-General of the World Health Organization, Dr. Tan Desai, pointed out at the COVID-19 Epidemic Media Briefing that the number of COVID-19 cases outside China has increased by 12 times in the past two weeks. The number has tripled, there were more than 118,000 cases in 114 countries, 4,291 people died[2].

Wuhan is not only the starting point of the epidemic in China but also the place where the number of newly diagnosed patients worldwide is most concentrated. Understanding the clinical characteristics of COVID-19 patients in Wuhan and the possible impact of various clinical factors on the prognosis are important to control the epidemic in Wuhan and the world[3]. Currently, there have been several studies on the clinical characteristics of patients with COVID-19 [4-5]. The results of these studies are inconsistent, and the research objects are concentrated in the early stage of the epidemic. Since February, the epidemic has entered an outbreak period[6]. In Wuhan of HubeiProvince, many “square cabin” hospitals were built urgently, and these were specifically used for the centralized treatment of mild COVID-19 patients; however, those in designated hospitals who treat relatively severe patientscurrently lack research reports on the clinical characteristics of inpatients during this period.

In addition, a few studies have reported the prognosis of patients with COVID-19 and the risk factors affecting the prognosis[7]. A multicenter, retrospective, observational study has shown that the risk factors of older age, multiple comorbidities, leukocytosis, lymphopenia and higher CT severity score could help clinicians identify patients with potential adverse events[8].In another retrospective cohort study,the potential risk factors of older age, high SOFA score, and d-dimer greater than 1 μg/L could help clinicians to identify patients with poor prognosis at an early stage[7].The estimation of risk factors for severe disease and death in these earlier case series were therefore very necessary. The estimation of risk factors for severe disease and death in these earlier case series are therefore very necessary. According to previous studies[7-9],we hypothesize that datas of emographic, clinical, treatment, and laboratory which might be associated with prognosis of patients with COVID-19. Therefore, this study retrospectively analyzed the clinical characteristics of patients diagnosed with COVID-19 in the Department of Respiratory Diseases of the First People's Hospital of Jiangxia District, Wuhan city and explored the risk factors affecting the prognosis of patients.

The study was registered in the Chinese Clinical Trial Registry (Registration Number: ChiCTR-OOC-17013223).URL:http://www.chictr.org.cn/edit.aspx?pid=51488&htm=4

METHODS

Study Design and Participants

This retrospective cohort study included cohorts of adult inpatients (≥18 years old) from the Department of Respiratory and Critical Care, The First People's Hospital of Jiangxia District, Wuhan(China) between January 29, 2020 and February 29, 2020. All adult patients who were diagnosed with COVID-19 according to WHO interim guidance were screened[10]. Our hospital is a tertiary general hospital with 1200 beds. On January 28, 2020, it became a designated hospital for admission of the COVID-19 patients, with a total of eight respiratory wards and one infectious disease ward, each with 60 beds, and one ICU ward with 25 beds. The ICU in our hospital can provide support therapy such as CRRT, Mechanical Ventilation, HFNC, etc. Patients requiring ECMO assistance can be transferred to Leishenshan hospital.

Exclusion criteria for the study was severely missing of patient’s data. The criteria for discharge were absence of fever for at least 3 days, substantial improvement in both lungs in chest CT, clinical remission of respiratory symptoms, and two throat-swab samples that were negative for severe acute respiratory syndrome coronavirus-2(SARS-CoV-2)RNA obtained at least 24 h apart[11].The study was approved by the Institutional Review Board (IRB) of The First People's Hospital of Jiangxia District(KY-2020–05), and the requirement for informed consent was waived by the IRB.

Data Collection

We retrieved clinical electronic medical records, nursing records, laboratory measurements,and radiological examinations for all patients with laboratory-confirmed infection of SARS-CoV-2. Laboratory confirmation of SARS-CoV-2 was performed by the Wuhan Center for Disease Prevention and Control.The collected data included the patient's epidemiological information, sex, age, underlying disease, admission date, discharge date, clinical symptoms before admission, maximum body temperature, routine blood tests, routine coagulation tests, biochemical and myocardial injury markers, hsCRP(hypersensitive C reactive protein), procalcitonin (PCT) and other laboratory tests at admission. Clinical data on antiviral treatment, whether to use antibacterial drugs, glucocorticoids and gamma globulin, whether to use high-flow oxygen, noninvasive ventilator or invasive ventilator, whether to switch to ICU treatment were collected. Clinical data of patients transferred to the ICU were continuously collected and discharged. All data were checked by

two physicians (JS and JY), and a third researcher (PF) adjudicated any differences in interpretation between the two primary reviewers.

Study Outcomes

The primary composite endpoint was admission to an ICU, use of mechanical ventilation, or death. These outcomes were used in a previous study to assess the severity of other serious infectious diseases, including COVID-19[6] and H7N9 infection[8]. Secondary endpoints were the rate of in-hospital death, length of stay in hospital,time of high-flow nasal cannula (HFNC)oxygen therapy or mechanical ventilation(MV).

Study Definitions

A confirmed case of COVID-19 was defined as a positive result with SARS-CoV-2 RNA by real-time RT-PCR or gene sequencing from sputum, throat swab, lower respiratory tract secretion, or other samples collected from patients. All patients were divided into a severe group and a nonsevere group. The illness severity of COVID-19 was defined according to the Chinese management guideline for COVID-19 (version 7.0)[11]. Mild cases were defined as:The clinical symptoms were mild, and there was no sign of pneumonia on imaging. Moderate cases were defined as:Showing fever and respiratory symptoms with radiological fifindings of pneumonia.Severe cases are featured by either: (1) respiratory rate >30 times/ min, or (2) oxygen saturation 93%, or (3) PaO2/FiO2 ratio 300 mmHg. The critically severe cases are diagnosed by either: (1) respiratory failure requiring mechanical ventilation, or (2) shock, or (3) combined other organ failure and needed ICU admission. The mild and moderate types were defined as the nonsevere group, and the severe and critical types were defined as the severe group. Fever was defined as an axillary temperature of 37.3°C or higher.

Statistical Analysis

We present continuous measurements as mean (SD) if they are normally distributed or median (IQR) if they are not, and categorical variables were presented as n (%). The Mann-Whitney U test, χ^2test, or Fisher's exact test were used to compare differences between the severe and nonsevere groups, where appropriate. To explore the risk factors associated with poor prognosis, univariable and multivariable logistic regression models were used.Data analysis was performed using SPSS 22.0 statistical software. P<0.05 was considered statistically significant.

RESULTS

Demographic and Clinical Characteristics of All Patients

Eighty-three patients with COVID-19 were included in this study(Figure 1), and all patients were residents of Wuhan. None of the patients were medical staff. Forty (48.2%) patients were men, with a mean age of 46 years(SD 14.4,21 to 83, Table 1). Twenty-six (31.3%) patients had chronic diseases, including hypertension, diabetes mellitus, chronic obstructive pulmonary disease, coronary artery disease, chronic liver disease, chronic renal disease, and malignancy. On admission, 76(91.6%) patients had fatigue. Sixty-one (73.5%) patients had fever, with a mean highest temperature before admission of 37.8°C. Half of the patients had cough. Other symptoms included shortness of breath, diarrhea, hemoptysis, muscle ache, and headache(Table 1). Of these patients, 17 were in the severe group (20.5%), and 66 were in the nonsevere group (79.5%). In the severe group, the proportions of basic diseases, including hypertension, diabetes, and malignant tumors, were significantly higher than those in the nonsevere group(P<0.05), and patients in the severe group were significantly older than those in the nonsevere group (P<0.05). (Table 1).

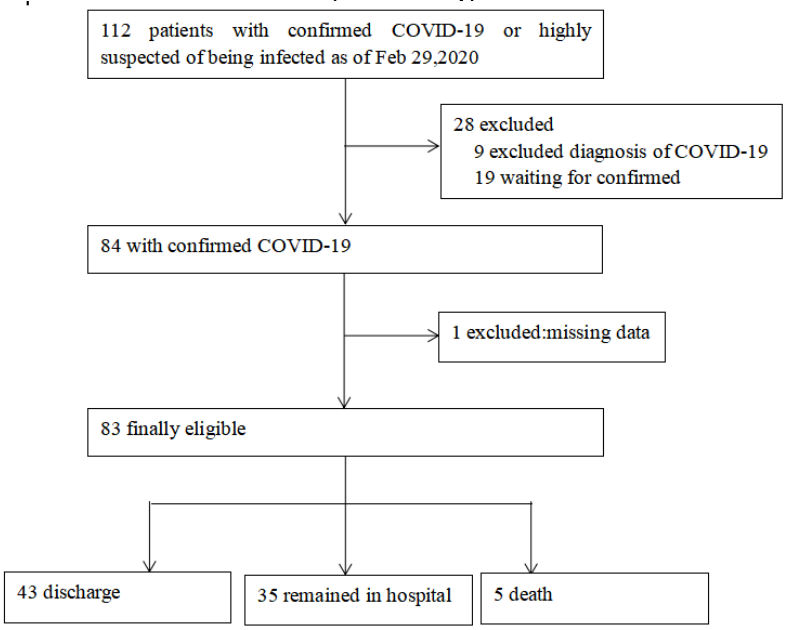
Table 1.
Clinical characteristics, laboratory parameters, treatments and clinical outcome of the COVID-19 patients.

Characteristic	All patients (N = 83)	Disease Severity		χ2/t	P value
		Severe (N = 17)	Nonsevere (N = 66)		
Age (yr, mean ± SD)	46±14.4	58.1±13.3	42.9±13	0.054	<0.001
Male, n (%)	40(48.2)	6(35.3)	34(51.5)	1.425	0.233
Exposure, n (%)					
Living in Wuhan	81(97.6)	16(94.1)	65(98.5)	1.083	0.298
Recently visited Wuhan	2(2.4)	1(5.9)	1(1.5)		
Clustered cases	12(14.5)	2(11.8)	10(15.2)	0.124	0.725
Smokers, n (%)	4(4.8)	1(5.9)	3(4.6)	0.052	0.82
Patients with comorbidities, n (%)					
Hypertension	15(18.1)	7(41.2)	8(12.1)	7.615	0.006
DM	7(8.4)	6(35.3)	1(1.5)	19.733	<0.001

COPD	1(1.2)	0(0)	1(1.5)	0.258	0.612
CAD	4(4.8)	3(17.7)	1(1.5)	7.577	0.006
CLD	3(3.6)	0(0)	3(4.6)	0.792	0.373
CRD	2(2.4)	1(5.9)	1(1.5)	1.083	0.298
Malignancy	1(1.2)	0(0)	1(1.5)	3.882	0.049
Other	3(3.6)	1(5.9)	2(3)	0.312	0.577
Symptoms, n (%)					
Cough	44(51)	8（47.1）	36（54.6）	0.304	0.581
Fever	61(73.5)	12(70.6)	49(74.2)	0.092	0.762
Fatigue	76(91.6)	16(94.1)	60(90.9)	0.178	0.673
Shortness of breath	7(8.4)	4(23.5)	3(4.6)	6.233	0.013
Hemoptysis	1(1.2)	0(0)	1(1.5)	0.258	0.612
Diarrhea	6(7.2)	2(11.8)	4(6.1)	0.648	0.421
Other	34(41)	10(58.8)	24(36.4)	2.82	0.093
Highest temperature before admission (oC，mean ± SD)	37.8±0.8	38.2±0.9	37.8±0.7	1.728	0.058
Chest CT findings, n (%)					
Unilateral pneumonia	28(33.7)	3(17.6)	25(37.9)	2.475	0.116
Bilateral pneumonia	55(66.3)	14(82.4)	41(62.1)		
Days from illness onset to admission	4.9±1.9	4.5±1.6	5±2	1.549	0.348
Days from illness onset to defined	8±2	8.7±1.8	7.8±2	1.141	0.104
Blood routine					
Leucocytes (×109/L)	4.8(3.6-6.9)	7.4(4.2-11.9)	4.65(3.5-6.1)	3.003	0.008
Lymphocytes (×109/L)	1.3±0.6	1.2±0.6	1.3±0.6	0.001	0.272
Platelets (×109/L)	195.7±82.1	187.4±94.7	197.8±79.1	1.515	0.644
Haemoglobin (g / L)	131.5±21	115±23.6	138.7±29.6	0.197	0.003
Coagulation function					
APTT (s)	30.2±3.9	30.2±4.8	30.2±3.8	2.708	0.993
PT (s)	12.5(11.6-13.7)	13.7(12.7-15.5)	12.3(11.6-13.34)	2.681	0.016
Fibrinogen (g / L)	4±1.1	4.5±1.2	3.9±1.1	0.001	0.073
D-dimer (mg / L)	0.2(0.1-0.4)	0.4(0.2-0.9)	0.2(0.1-0.3)	2.016	0.062
Blood biochemistry					
ALT (U / L)	30.7±31.3	26.1±19.4	31.8±33.8	0.943	0.504
AST (U / L)	26.9(21.2-34.2)	34.2(23-58.2)	26(20.6-32.25)	1.899	0.071
Total bilirubin (μmol/L)	8(5.6-13.3)	8.1(6.2-9.2)	7.95(5.1-13.6)	0.951	0.355
Albumin (g / L)	40.5±6.2	35.3±6.1	41.8±5.5	0.593	<0.001
FBG(mmol/L)	6.9±2.1	8.2±2.2	6.6±2.0	1.336	0.005
FBG>6.11mmol/L n(%)	54(65.1)	15(88.2)	39(51.1)	5.051	0.025
LDH (IU / L)	221(180-267)	362(217.5-583.2)	206.9(177.8-261)	2.666	0.017
Serum creatinine (μmol/L)	60.6(50.8-77.4)	61.2(47.3-113.7)	60.6(51.3-74.8)	1.502	0.152
Infection-related biomarkers					
HsCRP (mg / L)	10.7(1.9-35.8)	65.1(26.6-87.3)	6.8(1.3-21)	4.465	<0.001
Procalcitonin (pg / ml)	40(30-65)	150(350-475)	40(30-50)	2.042	0.058
Cardiac biomarkers					
HsTnT(pg/mL)	6(5-9)	8(5-56)	6(5-8)	1.947	0.069
Myoglobin(ng/mL)	24.1(21-44.8)	125.8(23.3-651.5)	21.4(21-35.8)	2.456	0.026
CK-MB(U/L)	14.3(13.8-19.8)	15.7(9.9-32.7)	14.1(11.8-18.8)	1.586	0.132
CK(U/L)	91(55-156)	145(41-313)	88(55-136.8)	1.642	0.12
Homocysteine(μmol/L)	12.2(9.8-15.1)	14.6(9.9-26.8)	11.7(9.8-14.5)	2.233	0.04
Antiviral treatment,n (%)					
Peramivir	72(86.8)	16(94.1)	56(84.9)	1.01	0.315
Arbidol	41(49.4)	11(64.7)	30(45.5)	2.004	0.157
Interferon	35(42.2)	8(47.1)	27(40.9)	0.21	0.647
Ribavirin	14(16.9)	0(0)	14(21.2)	4.285	0.038
Oseltamivir	2(2.4)	0(0)	2(3)	0.552	0.47
Antibiotics, n (%)					
Quinolones	69(83.1)	16(94.1)	53(80.3)	1.818	0.178
β-lactams	60(72.3)	14(82.4)	46(69.7)	1.068	0.301

Immunological therapy n (%)					
Immunoglobulin	46(55.4)	11(64.7)	35(53)	0.746	0.388
Glucocorticoids	63(75.9)	12(70.6)	51(77.3)	0.326	0.568
Clinical outcomes					
Presence of Composite Primary End Point, n (%)	13（15.7）	13(76.5)	0(0)	59.123	<0.001
HFNC or MV, n (%)	13(15.7)	13(76.5)	0(0)	59.123	<0.001
Admission to ICU, n (%)	5(6)	5(29.4)	0(0)	20.407	<0.001
HFNC or MV time(h)	0(0-0)	72(0-156)	0(0-0)	3.033	0.008
In-hospital death,n(%)	5(6)	5(29.4)	0(0)	20.407	<0.001
Length of stay in hospital (d)	17.3±7.1	16.8±9.3	17.4±6.5	0.251	0.805

Figure 1.
Study flow diagram



Laboratory Inspection

In the severe group, the white blood cell count, prothrombin time, arterial blood lactate, fasting blood glucose level, proportion of patients with fasting blood glucose> 6.11 mmol/L, HsCRP, myoglobin, and homocysteine were significantly higher than those in the nonsevere group, hemoglobin and albumin were significantly lower than those in the nonsevere group (both P<0.05), and there were no significant differences in the remaining laboratory examination indexes between the two groups (Table 1).

Antiviral and Antibacterial Treatments

In terms of antiviral therapy, 72 (86.8%) patients used paramivir, 41 (49.4%) and 35 (42.2%) patients used abidol and interferon, respectively. Another 14 (16.9%) patients received ribavirin, and 2 (2.4%) patients received oseltamivi. In terms of antibacterial drugs, the use rates of quinolone and β-lactam were as high as 83.1% and 72.3%, respectively. Quinolone included levofloxacin and moxifloxacin, and β-lactam included cefoperazone/sulbactam, cefotaxime, piperazine racillin/tazobactam, and imipenem. For immunotherapy, 46 (55.4%) and 63 (75.9%) patients were treated with gamma globulin and glucocorticoids, of which glucocorticoids were methylprednisolone injections. The use rate of ribavirin in the severe group was lower than that in the nonsevere group (P <0.05), and there were no significant differences between the two groups in other antiviral treatments, antibacterial use, and immunotherapy (Table 1).

Clinical Outcomes

A total of 13 patients with COVID-19 (15.7%) met the primary composite endpoint, including 10(12.0%) who underwent mechanical ventilation, 3(3.6%) who were treated with high-flow oxygen, 5(6.0%) who were admitted to the ICU, and 5(6.0%) who died, among them, one patient died of septic shock and four patients died of ARDS. The average high-flow or mechanical ventilation time was 72 (0,156) hours; the hospital mortality was 6%, and the average hospital stay was 17.3 ± 7.1 days. The proportion of primary composite

endpoints and patients transferred to the ICU, the high-flow nasal cannula or mechanical ventilation time, and the hospital mortality were significantly higher in the severe group than in the nonsevere group (P<0.05). (Table 1).

Logistic Regression Analysis of the Presence of the Primary Composite Endpoint

We first performed a univariate analysis of risk factors for poor prognosis in patients with COVID-19. The results showed that the age of the poor prognosis group, combined hypertension, diabetes, malignant tumors, two underlying diseases, the proportion of three or more basic diseases, white blood cell count, arterial blood lactate, fasting blood glucose, high-sensitivity C-reactive protein, and myoglobin were significantly higher than those with good prognosis, while hemoglobin and albumin were significantly lower in the poor prognosis group than in the good prognosis group (P<0.05); other factors were not statistically significant (Table 2). Logistic regression analysis showed that the increase in high-sensitivity C-reactive protein (1.063,1.02-1.108;p=0.004) or having diabetes (735.985,7.111-8444.318;P=0.002) was an independent risk factor for COVID-19 patients with poor prognosis; however, higher hemoglobin was associated with lower odds of poor prognosis(0.912, 0.856-0.97;P= 0.004). (Table 3).

Table 2 .
Univariate regression analysis of the presence of composite primary endpoints in patients with COVID-19.

Characteristic/Variable	Presence of Composite Primary End Point		χ2/t	P value
	Yes (N = 13)	No (N = 70)		
Age (yr, mean ± SD)	57.7±13.1	43.8±13.6	0.105	0.001
Male, n (%)	5(38.5)	35(50)	0.585	0.445
Smokers, n (%)	1(7.7)	3(4.29)	0.274	0.601
Patients with comorbidities, n (%)				
Hypertension	6(46.2)	9(12.9)	8.111	0.004
DM	5(38.5)	2(2.9)	16.292	<0.001
COPD	0(0)	1(1.4)	0.186	0.667
CAD	2(15.4)	2(2.9)	3.706	0.054
CLD	0(0)	3(4.3)	0.571	0.45
CRD	1(7.7)	1(1.4)	1.807	0.179
Malignancy	1(7.7)	0(0)	5.385	0.02
Only one comorbidity	3(23.1)	17(24.3)	0.009	0.926
Two comorbidities	3(23.1)	0(0)	16.558	<0.001
≥3 comorbidities	2(15.4)	1(1.4)	6.056	0.014
Blood routine				
Leucocytes (×109/L)	11.4(5.3-12.1)	4.65(3.6-6.1)	3.178	0.007
Lymphocytes (×109/L)	1.3±0.7	1.3±0.6	0.21	0.949
Platelets (×109/L)	184.2±98.6	187.8±79.2	1.629	0.584
Haemoglobin (g / L)	107.5±22	135.9±17.6	2.495	<0.001
Blood biochemistry				
Albumin (g / L)	34.9±6.2	41.5±5.7	0.348	<0.001
FBG(mmol/L)	8.2±2.3	6.7±2	1.285	0.019
FBG>6.11mmol/L n(%)	11(84.6)	43(61.4)	2.562	0.109
LDH (IU / L)	373(215-673.9)	211.4(179.5-261)	2.634	0.021
Coagulation function				
PT (s)	13.7(12.7-15.5)	12.4(11.6-13.5)	2.109	0.057
D-dimer (mg / L)	0.4(0.2-1.9)	0.2(0.1-0.4)	1.926	0.08
Infection-related biomarkers				
HsCRP (mg / L)	66.1(27.2-86.2)	7(1.6-26.2)	3.767	0.002
Procalcitonin (pg / ml)	150(35-715)	40(30-50)	1.941	0.076
Cardiac biomarkers				
HsTnT(pg/mL)	13(5-61)	6(5-8)	1.911	0.08
Myoglobin(ng/mL)	399.6(25-853.4)	22（21-39.3)	2.482	0.029

CK-MB(U/L)	18.9(13.8-56.3)	13.9(11.6-18.8)	1.688	0.117
CK(U/L)	196(41-313)	86(55-136.8)	1.416	0.182
Homocysteine(μmol/L)	15.6(9.9-36.2)	11.8(9.8-14.6)	2.107	0.056
Antiviral treatment, n (%)				
Peramivir	12(92.3)	60(85.7)	0.41	0.522
Arbidol	8(61.5)	33(47.1)	0.909	0.34
Interferon	6(46.2)	29(41.4)	0.1	0.751
Ribavirin	0(0)	14(20)	3.09	0.079
Antibiotics, n (%)				
Quinolones	12(92.3)	57(81.4)	0.914	0.339
β-lactams	10(76.9)	50(71.4)	0.163	0.686
immunological the-rapy n (%)				
Immunoglobulin	8(61.5)	38(54.3)	0.233	0.629
Glucocorticoids	10(76.9)	53(75.7)	0.009	0.926

Table 3.
Multivariate logistic regression analysis of the presence of composite primary endpoints in patients with COVID-19.

	B	SE	Wald	OR	P value	95%CI
Haemoglobin	-0.093	0.032	8.449	0.912	0.004	0.856-0.970
HsCRP	0.061	0.021	8.392	1.063	0.004	1.020-1.108
DM	5.501	1.806	9.279	245.042	0.002	7.111-8444.318
Constant	6.601	3.231	4.175	735.985	0.041	

DISCUSSION

This study showed that severe illness occurred in 20.5% of patients with COVID-19 after admission to a hospital. Severe patients with COVID-19 have more underlying diseases, including hypertension, diabetes, and malignant tumors, than nonsevere patients with COVID-19. Older patients with COVID-19 are more prone to severe illness. All 5 patients who died were severe patients with COVID-19. Furthermore, we identified some risk factors for poor prognosis in adults in Wuhan who were hospitalized with COVID-19. In the multivariable logistic regression model, we found that high hsCRP on admission and patients with DM were two independent risk factors of poor prognosis; however, higher hemoglobin was associated with lower odds of poor prognosis.

The fatality of patients infected by COVID-19 in our hospital was 6.0%, which is significantly higher than that of previous studies[6,7], and this does not resemble that in the whole national average level, which showed a rate of death of 3.2% among 51,857 cases of COVID-19[12]. One possible reason is that more severe patients were included in this study. Of the 83 patients included in this study, 17 (20.5%) were classified as severe patients, which was significantly higher than that of another study (15.7%)[6]. The primary composite endpoint, including admission to an ICU, use of mechanical ventilation, or death, was used in a previous study to assess the severity of serious infectious diseases, including COVID-19[6] and H7N9 infection[13]. Since HFNC oxygen therapy is widely used in the treatment of patients with hypoxemia or respiratory failure[14-15], we classified HFNC oxygen therapy as part of the composite endpoint. In this study, three patients experienced mild respiratory failure, which avoided using ventilator support after HFNC oxygen therapy.

Diabetes mellitus(DM) is a common comorbidity in septic patients[16-17]. A study has shown that DM in humans is associated with many deficiencies in the innate immune response, making these patients prone to infections and sepsis[16].A known history of diabetes and ambient hyperglycemia were independent predictors for death and morbidity in SARS patients. Metabolic control may improve the prognosis of SARS patients[19]. Zhou et al. reported that 19% of patients with COVID-19 had diabetes, and a higher proportion of patients who died had diabetes[7]. This study showed that the presence of any coexisting illness,including diabetes, was more common among severe patients with COVID-19 than among those with nonsevere patients with COVID-19. Furthermore, diabetes was an independent risk factor for COVID-19 patients with poor prognosis. Thus, COVID-19 patients with diabetes have more severe symptoms and have a worse prognosis, requiring more attention.

CRP is a sensitive marker of inflammation and tissue damage,and its level probably reflects sepsis severity; it is monitored routinely in hospitals [20-21]. A study showed that the CRP plasma level on admission independently predicted mortality

in patients with pneumonia[22]. In addition, a higher value of C-reactive protein was associated with the development of respiratory failure and subsequent intubation in patients with SARS[23].Significantly higher levels of C-reactive protein were associated with severe patients compared to nonsevere patients with COVID-19[24]. Similar to previous research, this study confirmed that higher CRP on admission was associated with poor prognosis in patients with COVID-19. Therefore, monitoring CRP helps us to identify and manage severe patients with COVID-19 as early as possible to improve patient prognosis.

Anemia is defined as hemoglobin<120g/L in adult male and <110g/ L in adult female (non-pregnant) at sea level, which is a common problem in patients with sepsis[25].Several mechanisms contribute to the reduction in hemoglobin levels in sepsis patients. Its possible mechanisms include reduced production of red blood cells induced by the systemic inflammatory response, as well as increased destruction of red cells due to infection or bleeding. The combination of anemia and high oxygen consumption induced by sepsis will augment the impairment of tissue oxygenation[26].A study showed a beneficial effect of higher hemoglobin levels on presentation and during the early stage of sepsis.Anemia combined with hypoxia increased the risk for death in SARS patients[27].This study showed that hemoglobin levels are significantly lower in severe patients with COVID-19 when admitted to the hospital than those in nonsevere patients with COVID-19. In addition, lower hemoglobin level was an independent risk factor for COVID-19 patients with poor prognosis. Thus patients with COVID-19 complicated by lower hemoglobin level tend to develop severe symptoms and have poor prognosis, requiring early intervention.

LIMITATION

First, as this study was retrospective, we could only include the hsCRPand hemoglobin levels on admission,which are less valid as a prognostic predictors

than the course of the hsCRPand hemoglobin levels, respectively. Furthermore, due to the limited number of study cases leading to fewer deaths, we chose the composite endpoint rather than the mortality rate as the criterion for judging the patient's prognosis. In the future, we will increase the number of included cases and use the mortality rate as the criterion for judging the patient's prognosis.

CONCLUSION

In conclusion, more than 20% of patients with COVID-19 developed severe symptoms with a poor prognosis. Furthermore, we found that high hsCRP on admission and patients with DM were two independent risk factors of poor prognosis; however, higher hemoglobin was associated with lower odds of poor prognosis.

These results may improve the risk stratification of patients with COVID-19 and help early detection and treatment of high-risk patients, thereby reducing the mortality of patients with COVID-19.

ABBREVIATIONS

COVID-19, coronavirus disease 2019; ICU, intensive care unit; SARS-CoV-2, severe acute respiratory syndrome coronavirus 2; IRB, Institutional Review Board; HFNC, high-flow nasal cannula, MV, mechanical ventilation; HsCRP, high-sensitivity C-reactive protein; DM, diabetesmellitus;

ETHICAL APPROVAL AND CONSENT TO PARTICIPATE

The study was approved by the Research Ethics Commission of The First People's Hospital of Jiangxia District (KY-2020–05), and the requirement for informed consent was waived by the Research Ethics Commission.

AVAILABILITY OF SUPPORTING DATA

The data are available from the corresponding author upon reasonable request.

COMPETING INTERESTS

All authors declare no competing interests.

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AUTHOR CONTRIBUTIONS

JS: Conceived and designed the experiments, performed data acquisition, wrote the first draft of the manuscript, and had full access to all the data in the study. **JY**: Performed data acquisition, analyzed the data, performed the statistical analysis and revised the manuscript. **PF**: Analyzed and interpreted the data and ensured that the accuracy and integrity of all work was appropriately maintained. **RZ**: Performed data acquisition, analyzed and interpreted the data and revised the manuscript. **QC**: Performed the statistical analysis, provided study supervision, and critically revised the manuscript for important intellectual content. All authors read and approved the final manuscript.

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Additional 1.
Lung lesions in initial chest CT of the patients with COVID-19

	All patients (N = 83)	Disease Severity		χ2/t	p value
		Severe (N = 17)	Nonsevere (N = 66)		
Number of affected lobes	2±1.5	4.5±0.9	1.4±0.7	1.605	<0.001
Patients number of 1 affected lobe, n (%)	50(60.2)	0(0)	50(75.8)	32.392	<0.001
Patients number of 2 affected lobe, n (%)	11(13.3)	1(5.9)	10(15.1)	0.998	0.318
Patients number of 3 affected lobe, n (%)	6(7.2)	1(5.9)	5(7.6)	0.057	0.811
Patients number of 4 affected lobe, n (%)	5(6)	4(23.5)	1(1.5)	11.433	0.001
Patients number of 5 affected lobe, n (%)	11(13.3)	11(64.7)	0(0)	48.637	<0.001
Number of ground glass opacities, n (%)	75(84.1)	12(70.6)	62(93.9)	7.533	0.006
Number of ground glass nodules, n (%)	17(20.5)	11(60.7)	6(9.1)	25.363	<0.001
Number of patchy consolidation, n (%)	15(18.1)	9(52.9)	6(9.1)	17.344	<0.001
Number of fibrous stripes, n (%)	13(15.7)	5(29.4)	8(12.1)	3.023	0.082
Number of irregular solid nodules, n (%)	8(9.6)	6(35.3)	2(3)	15.962	<0.001