Clinical characteristics study of elderly patients aged 75 or older with COVID-19 pneumonia in China

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Abstract

Background: Coronavirus disease 2019 (COVID-19), a newly emerged respiratory disease caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), has recently become pandemic. Clinical observation indicated that elderly patients had high incidence of severe pneumonia and poor treatment efficacy. Therefore, this study was to clarify the characteristics of elderly patients aged 75 or older with COVID-19 pneumonia in order to guide rational treatment for elderly patients.

Methods: we enrolled 331 elderly patients aged 75 or older with confirmed COVID-19 in Huoshenshan hospital of Wuhan from February 3rd to March 31st. The cases were divided into general, serious and critical groups according to severity after hospitalization, and the difference among groups were compared by R package statistics software.

Results: Compared with general group, serious and critical groups had more underlying comorbidities and higher incidence of cough, breath shortness and anorexia. Moreover, there existed obviously differences in many of laboratory indexes and CT images among them. serious and critical elderly patients were more likely to receive oxygen, mechanical ventilation, expectorant, corticosteroid, abidor, cephaloprin, imipenem, human serum albumin (HSA), nutrition support, anti SARS-CoV-2 positive plasma and actemra. Multivariate analysis of factors showed that male sex, hypertension, diabetes, renal diseases, breath shortness, neutrophil, platelet, creatinine, lactate dehydrogenase were the risk factor for serious and critical illness. While blood cell (WBC) was the protective factor.

Conclusion: elderly patients have high incidence of severe pneumonia and poor treatment efficacy. The reasons might be that many of the elderly patients with COVID-19 pneumonia have certain chronic disease, poor immune function and a meager response to the virus. the pathogenic mechanism of SARS-CoV-2 might be involved in the cell-mediated immunity and cytokine storms by acting on lymphocytes.

Introduction

Coronavirus disease 2019 (COVID-19), a newly emerged respiratory disease caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), has recently become pandemic [1]. This causative coronavirus was confirmed to be a distinct clade from the coronavirus that are enveloped, positive-sense, single-stranded RNA viruses with nucleocapsid of helical symmetry, which had widely been known to cause respiratory infection in humans after outbreak the “Sever Acute Respiratory Syndrome (SARS)” and “Middle East Respiratory Syndrome (MERS)” [2]. Although the mechanisms associated with the infectiousness of SARS-CoV-2 is not clear, Structural analysis suggests it is likely entering human cells through the ACE2 receptor and may be transmitted to human from the market where wild animals were sold out. According to the previous reports the SARS-CoV-2 are thought to have originated in bats [3, 4]. the epidemiological data demonstrated person-to-person transmission by droplet respiratory, touch and otherwise.

Clinical characteristics associated with patients infected with SARS-CoV-2 range from mild respiratory illness to serious acute respiratory disease. Pneumonia appears to be the most frequent manifestation of SARS-CoV-2 infection, characterized primarily by fever, cough, fatigue and breath shortness. Generally, it is

thought that the period from infection to appearance of symptoms varies was 14 days, the onset of fever and respiratory symptoms occurred approximately three to six days after presumptive exposure [5, 6]. Although numerous compounds had been proven effective against virus, there was no obvious effect on newly emerged SARS-CoV-2. The main therapeutic strategy focused on symptomatic support [2].

Our clinical observation indicated that elderly patients have high incidence of severe pneumonia, acute respiratory distress syndrome (ARDS), even multiple organ failure than other patients, and showed poor treatment efficacy after hospitalization. However, large-scale analyses of clinical characteristics of elderly patients had been scarce. In this study, we aimed to clarify the characteristics of elderly patients aged 75 or older with COVID-19 in order to guide rational treatment for elder patients.

Methods

Study design and participant

This study was a retrospective cohort study of Wuhan Huoshenshan hospital and approved by the ethics committee of Wuhan Huoshenshan Hospital (No. HSSLL024). All elderly patients aged 75 or older (331 cases) with confirmed COVID-19 admitted to Huoshenshan Hospital of Wuhan from February 3rd to March 31st were enrolled, which occupied almost 1/10 of total number of patients in Huoshenshan hospital. Written or oral informed consent was obtained from these elderly patients.

Definitions

COVID-19 was confirmed by detecting SARS-CoV-2 RNA in throat or/and nasal swab samples using a virus nucleic acid detection kit according to the manufacturer's protocol (Luoyang Eisen Biotechnology Co.,Ltd) in class III bio-safety lab of Huoshenshan hospital. Depending on illness severity, the elderly patient with COVID-19 pneumonia were grouped as general, serious and critical group [7]. serious group was defined if satisfying at least one of the following items:1) breathing rate ≥ 30/min; 2) pulse oximeter oxygen saturation (SpO2) ≤ 93%; 3) ration of partial pressure of arterial oxygen (PaO2) to fraction of inspired oxygen (FiO2) ≤ 300 mmHg. Critical group was defined if satisfying at least one of the following items: 1) respiratory failure occurred and received mechanical ventilation; 2) shock; 3) combined with failure of other organs and received care in the intensive care unit (ICU). Otherwise, it was classified as general group. (Figure.1 showed the chest-image dynamics of general and serious COVID-19). The criteria for evaluating rehabilitation of COVID-19 patient were 1) two consecutive test of SARS-CoV-2 RNA in throat swab samples was negative; 2) obvious alleviation of respiratory symptoms (e.g. cough, fatigue and breath shortness) ; 3) maintenance of normal body temperature for ≥ 3 days without the use of corticosteroid or antipyretics; 4) improvement in radiological abnormalities by chest CT detection [7].

Data collection

A COVID-19 case report form was designed to document primary data. The following information was extracted from all elderly patient (aged 75 or older): age, gender, medical history, symptoms, severity assessment, laboratory findings, chest CT findings and treatment from electronic medical records.

Statistical analysis

Categorical data were described as percentages, and continuous data were described as median with inter-quartile range (IQR). Nonparametric comparative test for continuous data and X^2 test for categorical data were used to compare variables among groups. $P < 0.05$ was considered statistically significant. The variables identified by univariate analysis ($p < 0.05$) were put into the multivariate analysis, in which these variables were adjusted by disease severity. All statistical analyses were performed using R package statistics software.

Results

Characteristics of medical history

331 elderly patients aged 75 or older with COVID-19 pneumonia were included in this study (table.1). 160 (48.3%), 143 (43.2%) and 28 (8.5%) patients were categorized into general, serious and critical groups respectively according to the severity of illness. 27 (8.2%) elderly patients died after admission. The median age of elderly patients with COVID-19 pneumonia was 80 years (IOR: 77 ~ 84), and 180 (54.4%) patients were male. 254 (76.7%) patients had at least one comorbidity, including hypertension (56.8%), diabetes (30.5%), cardiovascular diseases (27.2%), chronic renal diseases (11.5%) and COPD (11.8%). Fever (62.5%), cough (63.8%), breath shortness (63.4%) and fatigue (50.2%) were the most common symptoms in COVID-19. While neurological symptoms (headache 1.8% and dizziness 2.4%) and gastrointestinal symptoms (anorexia, 9.7%; diarrhea, 7.3%; abdominal pain, 1.8%; nausea, 1.5% and vomiting, 0.9%) were scare. Compared with these general groups, serious and critical groups were male dominated ($p < 0.001$), had more other chronic diseases including hypertension ($p < 0.01$), diabetes ($p < 0.01$), cardiovascular disease ($p < 0.01$), cerebrovascular disease ($p < 0.01$), chronic renal disease ($p < 0.01$) and COPD ($p < 0.01$), and higher incidence of cough ($p < 0.01$), breath shortness ($p < 0.01$) and anorexia ($p < 0.01$). Meanwhile, the critical elderly patients with COVID-19 pneumonia had the higher mortality ($p < 0.01$) than others.

Table 1. characteristics of medical history of elderly patients with COVID-19 pneumonia

	No (%)				P value
	Total (n=331)	General (n=160)	Serious (n=143)	Critical (n=28)	
Age, median (IOR), years	80 (77~84)	80 (78~84)	79 (77~84.5)	81.5 (77.8~84)	0.46
Male	180 (54.4)	65 (40.6)	95 (67.1)	19 (67.9)	<0.01
Hypertension	188 (56.8)	70 (43.8)	97 (67.8)	21 (75.0)	<0.01
Diabetes	101 (30.5)	26 (16.3)	63 (44.06)	12 (42.9)	<0.01
Cardiovascular diseases	90 (27.2)	29 (18.1)	53 (37.1)	8 (28.6)	<0.01
Cerebrovascular disease	51 (15.4)	19 (11.9)	18 (12.6)	14 (50)	<0.01
Malignancy	20(6.0)	7 (4.4)	10 (6.99)	3 (10.7)	0.35
Chronic liver diseases	8 (2.4)	5 (3.1)	3 (2.1)	0 (0.0)	0.58
Chronic renal diseases	38 (11.5)	5 (3.1)	25 (17.5)	8 (28.6)	<0.01
COPD	39 (11.8)	11 (6.9)	23 (16.1)	6 (21.4)	<0.01
Fever	207 (62.5)	96 (60)	93 (65)	18 (64.3)	0.65
Max temperature, (IOR), ℃	38.5 (38.0~39.0)	38.3 (37.9~38.6)	38.5 (38~38.9)	39.0 (38.3~39)	0.03
Cough	211 (63.8)	84 (52.5)	111 (77.6)	16 (57.1)	<0.01
Chest pain	10 (3.0)	5 (3.1)	5 (3.5)	0 (0.0)	0.61
Fatigue	166 (50.2)	77 (48.1)	73 (51.1)	16 (57.1)	0.65
Breath shortness	210 (63.4)	73 (45.62)	109 (76.2)	28 (100.0)	<0.01
Myalgia or arthralgia	72 (21.8)	35 (21.9)	35 (24.5)	2 (7.14)	0.13
Headache	6 (1.8)	2 (1.3)	3 (2.1)	1 (3.6)	0.66
Dizziness	8 (2.4)	6 (3.8)	2 (1.4)	0 (0.0)	0.28
Anorexia	32 (9.7)	10 (6.3)	12 (8.4)	10 (35.7)	<0.01
Diarrhea	24 (7.3)	9 (5.6)	13 (9.1)	2 (7.1)	0.51
Abdominal pain	6 (1.8)	1 (0.6)	5 (3.5)	0 (0.0)	0.13
Nausea	5 (1.5)	2 (1.3)	2 (1.4)	1 (3.6)	0.64
Vomiting	3 (0.9)	1 (0.6)	2 (1.4)	0 (0.0)	0.68
Death	27 (8.2)	0 (0.0)	5 (3.5)	22 (78.6)	<0.01

IQR, interquartile range; COPD, chronic obstructive pulmonary disease; COVID-19, coronavirus disease 2019; No, number.

Laboratory findings and chest CT images

As described in table.2, most elderly patients aged 75 or older with COVID-19 pneumonia had the abnormalities of blood routing (e.g. WBC, Neutrophil, lymphocyte and platelet), lymphocyte subgroups (eg. $CD3^+$ T cell, $CD3^+CD4^+$ Th cell, $CD3^+CD8^+$ CTL), blood biochemistry (e.g. ALT, AST, albumin, creatinine, LDH, CK), D-dimer, infection-related biomarkers (CRP, IL-6 and procalcitonin) after admission. Meanwhile, typical images of pulmonary infection were showed in chest CT images of 222 (67.1%) cases. Compared with general group, serious and critical groups had a higher level of WBC ($p < 0.01$), neutrophils ($p < 0.01$), ALT ($p = 0.03$), AST ($p < 0.01$), creatinine ($p < 0.01$), LDH ($p < 0.01$), CK ($p = 0.02$), D-dimer ($p < 0.01$), CRP ($p < 0.01$), IL-6 ($p < 0.01$) and procalcitonin ($p < 0.01$), and a larger area of pulmonary infection ($p < 0.01$). however, there were lower level of lymphocyte ($p < 0.01$) and albumin ($p < 0.01$) in serious and critical groups, especially, T lymphocyte subgroups, including $CD3^+$ T cell ($p < 0.01$), $CD3^+CD4^+$ Th cell ($p < 0.01$),

$CD3^+CD8^+$ CTL ($p < 0.01$), which assayed with flow cytometry technique and CD series of monoclonal antibodies of human T lymphocytes.

Table.2 Laboratory and chest CT findings of elderly patients with COVID-19 pneumonia

	Normal range	Median (IQR)				P value
		Total (n=331)	General (n=160)	Serious (n=143)	Critical (n=28)	
Blood routine						
WBC, $\times 10^9$/L	3.5~9.5	5.8 (4.6~7.6)	5.7 (4.7~7.0)	5.8 (4.3~7.6)	8.4 (6.7~10.6)	<0.01
Neutrophils $\times 10^9$/L	1.8~6.3	3.89 (2.78~5.40)	3.66 (2.69~4.97)	3.79 (2.74~5.50)	7.08 (5.19~9.24)	<0.01
Lymphocyte, $\times 10^9$/L	1.1~3.2	1.10 (0.79~1.49)	1.19 (0.92~1.59)	1.08 (0.78~1.48)	0.69 (0.45~0.93)	<0.01
Platelet, $\times 10^9$/L	125~350	210 (158~267)	205 (165~261)	226 (165~275)	136 (83~206)	<0.01
Lymphocyte subgroups						
$CD3^+$ (T cell), %	59~85	63.2 (52.0~72.8)	76.1 (67.2~79.4)	56.1 (50.8~66.4)	40.8 (31.5~52.1)	<0.01
$CD3^+CD4^+$(Th cell), %	29~61	35.8 (26.6~42.5)	42.5 (40.2~45.5)	33.2 (26.1~38.4)	22.4 (15.7~25.1)	<0.01
$CD3^+CD8^+$ (CTL), %	11~38	22.1 (17.5~26.2)	26.1 (23.6~30.2)	20.1 (18.4~25.2)	11.3 (10.5~15.5)	<0.01
$CD3^+CD4^+/CD3^+CD8^+$	0.9~3.6	1.6 (1.4~1.9)	1.6 (1.4~2.0)	1.7 (1.3~1.9)	1.6 (1.5~1.9)	0.85
$CD3^-CD19^+$(B cell),%	6.4~23	9.2 (5.7~13.1)	8.9 (6.6~10.5)	9.6 (5.3~13.4)	8.7 (5.5~15.2)	0.97
$CD3^-(CD16^+/CD56^+)$ (NK cell), %	5.6~31	18.0 (12.8~24.4)	18.7 (12.5~24.9)	16.5 (13~19.8)	26.0 (15.8~31.0)	0.23
Blood biochemistry						
ALT, U/L	7~40	17.3 (11.6~27.3)	15.4 (10.8~23.8)	18.2 (17.8~30.1)_	20.1 (14.8~36.8)	0.03
AST, U/L	7~45	21.2 (16.3~28.8)	20.2 (16.1~25.2)	21.7 (16.5~31.7)	30.8 (20.2~42.2)	<0.01
Albumin, g/L	40~55	34.7 (31.0~36.9)	35.3 (32.4~37.3)	33.9 (30.2~36.8)	33.3 (29.6~35.1)	<0.01
Globulin, g/L	20~40	27.9 (25.3~31.0)	28.1 (25.7~30.9)	28.1 (24.9~31.7)	27.6 (24.7~29.7)	0.73
Creatinine, μmol/L	41~81	69.1 (56.9~82.2)	66.3 (56.2~76.1)	72.3 (57.5~91.2)	80.3 (65.6~105.9)	<0.01
LDH, U/L	120~250	205.1 (175.1~259.2)	193.2 (162.6~229.5)	212.5 (182.2~258.4)	308.4 (251.9~476.3)	<0.01
CK, U/L	24~170	45.2 (31.4~77.8)	43.3 (31.4~72.2)	45.2 (31.3~67.4)	120.2 (36.4~197.1)	0.02
Coagulation function						
D-dimer, ng/mL	0~0.55	1.03 (0.64~2.03)	0.91 (0.62~1.67)	1.11 (0.56~2.28)	3.43 (1.28~6.25)	<0.01
Infection-related biomarkers						
CRP mg/L	0~4	9.65 (2.75~37.59)	6.11 (1.95~25.26)	11.22 (3.22~38.97)	67.23 (30.44~129.44)	<0.01
IL-6, pg/ml	<7	6.39 (2.74~19.92)	4.70 (2.51~12.32)	7.81 (2.74~28.36)	82.94 (38.96~179.10)	<0.01
Procalcitonin, ng/ml	0~0.05	0.06	0.05	0.07	0.45	<0.01

		(0.04~0.13)	(0.04~0.08)	(0.04~0.12)	(0.16~0.69)	
SARS-CoV-2 antibody						
IgM	<10	16.56	14.49	27.74	6.52	0.16
		(4.77~50.92)	(4.36~47.60)	(5.82~56.81)	(2.04~25.67)	
IgG	<10	152.76	153.35	153.19	79.57	0.55
		(79.22~185.97)	(59.79~185.88)	(93.17~184.55)	(3.11~197.45)	
Chest CT images						
Pulmonary infection proportion, %		10.1 (3.1~20.2) n=222	7.6 (2.0~14.8) n=114	13.3 (5.5~23.8) n=106	22.6 (21.4~23.7) n=2	<0.01
pulmonary infection area, cm^3		313.2 (97.2~556.8) n=222	204.8 (57.4~418.6) n=114	401.5 (161.4~681.3) n=106	361.9 (355.2~368.5) n=2	<0.01

ALT: Alanine aminotransferase; AST: Aspartate aminotransferase; LDH:Lactate dehydrogenase; IL-6: Interleukin-6; CRP: C-reactive protein; CK: Creatine Kinase; IQR: interquartile range; Th cells: T helper cells; CTL: cytotoxic T cells;

Treatment

Of the 331 elderly patients with COVID-19 pneumonia (table.3), 201 (60.7%) patients received oxygen, and 39 (11.8%) with mechanical ventilation. 176 (53.2%) patients received expectorant. 78 (23.6%) patients received intravenous corticosteroid. 178 (53.8%) patients received at least one antiviral treatment (arbidor, 46.2%; Oseltamivir, 10.0%; ribavirin, 3.9% and interferon inhalation, 9.1%). 177 (53.5%) patients received at least one antibacterial drug treatment (moxifloxacin, 38.1%; cephalosporin, 21.8%; levofloxacin, 6.3% and imipenem, 8.8%). 107 (32.3%) patients received immune enhancing treatment including thymalfasin and/or immunoglobulin. 116 (35.1%) patients received nutrition support including parenteral nutrition (PN) or/and enteral nutrition (EN), and 76 (23%) patients received human serum albumin (HSA) supplement. The frequency of administration of Chinese traditional medicine and Lianhua Qinwen cpsule (a kind of Chinese patent drugs) were 61.3% and 49.2% respectively. 4 (1.2%) patients received mesenchymal stem cell (MSC) therapy, 26 (7.9%) patients received anti SARS-CoV-2 positive fresh plasma therapy, and 20 (6.0%) patients were treated by actemra after obtaining informed consent. In additional, 5 (1.5%) patients were treated with combination chloroquine and azithromycin. Compared with general group, serious and critical groups were more likely to receive oxygen ($p < 0.01$), mechanical ventilation ($p < 0.01$), nutrition support ($p < 0.01$) and drug therapy, including abidor ($p < 0.01$), expectorant ($p = 0.03$), corticosteroid ($p < 0.01$), cephaloprin ($p < 0.01$), imipenem ($p < 0.01$), HSA ($p < 0.01$), anti SARS-CoV-2 positive plasma ($p < 0.01$) and actemra ($p < 0.01$).

Table.3 Treatment of elderly patients with COVID-19 pneumonia

	No. (%)				P value
	Total (n=331)	General (n=160)	Serious (n=143)	Critical (n=28)	
Oxygen	201 (60.7)	91 (56.9)	82 (57.3)	28 (100)	<0.01
Mechanical ventilation	39 (11.8)	5 (3.1)	6 (4.2)	28 (100)	<0.01
Expectorant	176 (53.2)	73 (45.6)	87 (60.8)	16 (57.1)	0.03
Corticosteroid	78 (23.6)	22 (13.8)	38 (26.6)	18 (64.3)	<0.01
Abidor	153 (46.2)	56 (35.0)	80 (55.9)	17 (60.7)	<0.01
Oseltamivir	33 (10.0)	16 (10)	17 (11.9)	0 (0)	0.16
Ribavirin	13 (3.9)	4 (2.5)	8 (5.6)	1 (3.6)	0.38
Interferon inhalation	30 (9.1)	12 (7.5)	17 (11.9)	1 (3.6)	0.24
Chloroquine	5 (1.5)	2 (1.3)	0 (0.0)	3 (10.7)	<0.01
Azithromycin	8 (2.4)	2 (1.25)	3 (2.1)	3 (10.7)	0.01
Moxifloxacin	126 (38.1)	53 (33.1)	60 (42.0)	13 (46.4)	0.18
Cephaloporin	72 (21.8)	23 (14.4)	37 (25.9)	12 (42.9)	<0.01
Levofloxacin	21 (6.3)	8 (5.0)	10 (7.0)	3 (10.7)	0.48
Imipenem	29 (8.8)	3 (1.9)	8 (5.6)	18 (64.3)	<0.01
Immune enhancer (Thymalfasin or Immunoglobulin)	107 (32.3)	39 (24.4)	51 (35.7)	17 (60.7)	<0.01
Anti SARS-CoV-2 positive plasma	26 (7.9)	7 (4.4)	17 (11.9)	2 (7.1)	<0.05
Chinese traditional medicine	203 (61.3)	108 (67.5)	87 (60.8)	8 (28.6)	<0.01
Lianhua Qingwen Capsule	163 (49.2)	85 (53.1)	70 (49.0)	8 (28.6)	0.06
HSA	76 (23.0)	16 (10)	36 (25.2)	24 (85.7)	<0.01
Nutrition support (PN or/and EN)	116 (35.1)	40 (25.0)	53 (37.1)	23 (82.1)	<0.01
MSC	4 (1.2)	1 (0.6)	2 (1.4)	1 (3.6)	0.40
Actemra	20 (6.0)	2 (1.3)	15 (10.5)	3 (10.7)	<0.01

HSA: human serum albumin. MSC: Mesenchyma stem cell; PN: parenteral nutrition EN: enteral nutrition (EN)

Multivariate analysis of factors associated with elderly patients with COVID-19 pneumonia

37 significant factors in univariate analysis were put into the multivariate analysis to identify reliable predictive factor for elderly patients with COVID-19 pneumonia (table.4). The results indicated male sex (p = 0.002; OR: 3.383, 95% CI: 1.570 ~ 7.523), hypertension (p = 0.007; OR:2.821, 95% CI:1.345–6.108), diabetes (p < 0.001; OR: 4.795, 95% CI:2.177 ~ 11.087), renal diseases (p = 0.029, OR:5.213, 95% CI:1.314 ~ 26.476) and breath shortness (p < 0.001, OR:4.828, 95% CI:2.132 ~ 11.608) as the risk factor for elderly patients. In laboratory finding, WBC as the protective factor (p = 0.045, OR: 0.475, 95% CI: 0.217 ~ 0.971), Neutrophil (p = 0.035, OR:2.197, 95% CI:1.065 ~ 4.856), platelet (p = 0.032, OR: 1.005, 95% CI:1.001 ~ 1.010), creatinine (p = 0.032, OR:1.021, 95% CI:1.003 ~ 1.041), lactate dehydrogenase (p = 0.005, OR: 1.007, 95% CI:1.002 ~ 1.013)as the risk factors. Compared with general group, serious and critical groups were more likely to receive abidor (p = 0.006, OR: 2.992, 95% CI: 1.396 ~ 6.675), human serum albumin (p = 0.038, OR: 3.663, 95% CI: 1.105 ~ 12.990), actemra (p = 0.040, OR: 6.879, 95% CI:1.244 ~ 56.646).

Table.4. Multivariate analysis of factors associated with elderly patients with COVID-19 pneumonia

	Estimate	Std.Error	OR (95% CI)	P value
Male	1.219	0.396	3.383 (1.570~7.523)	0.002
Hypertension	1.037	0.384	2.821 (1.345~6.108)	0.007
Diabetes	1.567	0.413	4.795 (2.177~11.087)	<0.001
Cardiovascular disease	0.367	0.429	1.443 (0.623~3.379)	0.393
Cerebrovascular disease	-0.754	0.591	0.470 (0.145-1.494)	0.202
Renal diseases	1.651	0.755	5.213 (1.314~26.476)	0.029
cough	0.448	0.396	1.565 (0.721~3.428)	0.258
Breath shortness	1.574	0.430	4.828 (2.132~11.608)	<0.001
Anorexia	0.572	0.716	1.773 (0.446~7.583)	0.424
Laboratory findings				
WBC	-0.745	0.371	0.475 (0.217~0.971)	0.045
Neutrophil	0.787	0.372	2.197 (1.065~4.856)	0.035
lymphocyte	0.383	0.461	1.467 (0.601~3.761)	0.406
Platelet	0.005	0.002	1.005 (1.001~1.010)	0.032
Alanine aminotransferase,	0.009	0.012	1.009 (0.987~1.034)	0.449
Aspartate aminotransferase	-0.017	0.012	0.983 (0.960~1.005)	0.159
Albumin	-0.002	0.044	0.998 (0.919~1.094)	0.970
Creatinine	0.021	0.010	1.021 (1.003~1.041)	0.032
Lactate dehydrogenase	0.007	0.003	1.007 (1.002~1.013)	0.005
Creatine Kinase	0.000	0.003	1.000 (0.995~1.005)	0.989
D-dimer	0.071	0.098	1.073 (0.883~1.302)	0.470
C-reactive protein	0.004	0.006	1.004 (0.995~1.018)	0.517
Treatment				
Oxygen	-0.335	0.409	0.716 (0.316~1.586)	0.413
Mechanical ventilation	-1.688	1.081	0.185 (0.022~1.568)	0.118
Expectorant	0.081	0.387	1.084 (0.502~2.312)	0.835
Corticosteroid	0.155	0.512	0.856 (0.311~2.346)	0.762
Abidor	1.096	0.397	2.992 (1.396~6.675)	0.006
Chloroquine	-0.177	1.790	0.838 (0.022~25.155)	0.921
Azithromycin	1.045	1.127	2.843 (0.323~32.337)	0.354
Cephalosporin	0.452	0.498	1.571 (0.596~4.264)	0.365
Imipenem	1.112	1.221	3.041 (0.322~43.315)	0.362
Chinese medicine	-0.361	0.402	0.697 (0.314~1.531)	0.369
Lianhua Qingwen Capsule	-0.033	0.397	0.967 (0.442~2.111)	0.933
Immune enhancer (Thymalfasin or Immunoglobulin)	-0.603	0.428	0.547 (0.232~1.254)	0.159
Anti SARS-CoV-2 positive plasma	0.881	0.745	2.412 (0.575~10.983)	0.237
HSA	1.298	0.624	3.663	0.038

			(1.105~12.990)	
Nutrition support (PN or/and EN)	0.428	0.477	1.534 (0.605~3.964)	0.370
Actemra	1.928	0.939	6.879 (1.244~56.646)	0.040

HSA: human serum albumin. OR: odds ratio; CI: confidence interval.

Discussion

Since the outbreak of COVID-19, the number of patients had increased dramatically in the word. It had been reported that COVID-19 exhibit mild to moderate symptoms, but approximately 15% progress to severe pneumonia and about 5% eventually develop ARDS, septic shock and/or multiple organ failure [1]. Especially, Elderly patients had a significantly higher prevalence of severe pneumonia, who had an exacerbation in clinical symptoms, laboratory findings and CT images [7]. Therefore, clinicians should assess the severity of illness timely and provide interventions for elder patients with COVID-19 pneumonia, which was conductive to shorten the course of disease, prevent disease progression and reduce mortality.

In this study, 331 elderly patients with COVID-19 pneumonia were divided into general, serious and critical groups according to the severity of illness. it could be seen that 254 (76.7%) of elderly patients have certain chronic diseases and were worse than others. This was why elderly patients have high incidence of severe pneumonia and poor treatment efficacy. COVID-19 was like SARS and MERS in some clinical manifestations. In COVID-19 patients, fever, cough and breath shortness were most common symptoms, followed by fatigue and myalgia. However, neurological symptoms (e.g. headache and dizziness), gastrointestinal symptoms (e.g. Diarrhea, abdominal pain, nausea, vomiting) and upper respiratory tract symptoms (eg. nasal congestion, nasal discharge and sore throat) were relatively rare. Fever occurred in 98 ~ 100% of SARS or MERS patients, compared to 62.5% elderly patients with COVID-19 pneumonia in this study [8]. this result suggested that elderly patients may be have poor immune function and a meager response to the SARS-CoV-2. This was another reason why elderly patient have high incidence of severe pneumonia and poor treatment efficacy. It was worth noting that 37.5% of elderly patients presented no fever, suggesting that the absence of fever could not rule out the possibility of COVID-19. if fever was used to trigger detection for COVID-19, a substantial number of elderly patients without fever might be missed.

In radiological image findings, 222 (67.1%) elderly patients had abnormal chest CT findings. The lung lesions were mainly manifested as ground glass-like shadows and patchy shadows on CT image. Serious and critical groups had a higher proportion of pulmonary infection than general group, suggesting a more obvious inflammatory response in the lung. These results indicated that SARS-CoV-2 mainly destroyed and impaired the alveolar epithelial cells. In laboratory findings, there existed obviously differences in the number of WBC, neutrophil, lymphocyte and platelet, serious and critical groups had lymphopenia, and the proportion of T lymphocyte subgroups (including $CD3^+$ T cell, $CD3^+CD4^+$ Th cell, $CD3^+CD8^+$ CTL) significantly lower in serious and critical groups than that of general group. Meanwhile, the levels of ALT, AST, creatine, and CK in blood significantly increased in serious and critical groups. It was known that ALT and AST were important indicators of liver function, creatine was a kind of intelligent indicator of renal

function and CK was a sensitive indicator of heat function. The increase of these indicators might be associated with some chronic diseases or/and irrational use of drug in these elderly patients. In additional, LDH, CRP and IL-6 were statistically significantly higher in serious and critical groups, LDH was an inflammatory predictor in many pulmonary diseases, such as obstructive disease, microbial pulmonary disease and interstitial pulmonary disease [7]. CRP as a widely used biochemical marker for inflammation, reflecting the acute sever systemic inflammatory response caused by viral infection. IL-6 is one of the irreplaceable cytokines in the inflammatory response and may play a key role in pathogenesis and progress of pulmonary caused by the virus. These indicated that SARS-CoV-2 might mainly act on lymphocytes, including $CD3^+$ T cell, $CD3^+CD4^+$ Th cell, $CD3^+CD8^+$ CTL, and involve in the cell-mediated immunity and cytokine storms. But the exact mechanism needs to investigate further.

So far, there was no safe and effective treatment for COVID-19 in clinical application, because of poor efficacy and/or adverse reaction. Most patients recovered despite receiving antiviral, immunity enhancement and anti-inflammatory treatment, but it was more due to the supportive care with oxygen, nutrition support as needed, intensive care management. In present study, serious and critical elderly patients were more likely to receive oxygen therapy, ventilator support, corticosteroid, antivirals, antibacterial, immune enhancer and anti-inflammatory treatment, indicating these elderly patients may be have more severe state, more complication and worse prognosis, which seem to be causing a delay of the clinical course, even death.

In conclusion, more than 50% COVID-19 elderly patients were serious or critical illness, indicating elderly patients have high incidence of severe pneumonia and poor treatment efficacy. The reasons might be that many of the elderly patients have certain chronic disease, poor immune function and a meager response to the virus. the pathogenic mechanism of SARS-CoV-2 might be involved in the cell-mediated immunity and cytokine storms by acting on lymphocytes, but the exact mechanism needs to investigate further.

Declarations

Ethics approval and consent to participate

This study was a retrospective cohort study of Wuhan Huoshenshan hospital and approved by the ethics committee of Wuhan Huoshenshan Hospital (No. HSSLL024).

Consent for publication

All authors reached an agreement to publish the study in this journal

Availability of data and materials

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

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

Qing Mao and Hu Liu designed the study. Chao Zhang wrote the manuscript. Hua Fu, Long Zhang analyzed the data. Yuxiong Yin and Jing Lin supported the clinical data. All authors read and approved the final manuscript.

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