Original Article

The features comparison between patients in the ICU and general wards and between patients with different outcomes: a 2020 COVID-19 study

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Background: The novel 2019 coronavirus (COVID-19) has largely abated in China; however, sporadic or imported cases are still a concern, while in other countries, the COVID-19 pandemic persists as a major health crisis.

Methods: All patients enrolled in this study were diagnosed with COVID-19 from February 21, 2020 to April 14, 2020 in Wuhan. We retrospectively analyzed the patients admitted to the ICU (137 patients) and general wards (114 patients) of Wuhan Leishenshan Hospital in China. The population characteristics, symptoms, and laboratory examination results between the patients in the ICU and those in the general wards were compared. Furthermore, the differences between the deceased patients in the ICU and those discharged from the ICU were compared.

Results: There were significant differences between the two groups in terms of symptoms, including fever, shortness of breath, no presence of complications, presence of 1 complication, and presence of 3 or more complications ($P<0.05$). There were also significant differences between the patients in terms of the laboratory examination results including elevated urea nitrogen, creatinine, direct bilirubin, aspartate aminotransferase, total protein, albumin, creatine kinase, lactate dehydrogenase, procalcitonin, erythrocyte sedimentation rate, white blood cells, C-reactive protein, prothrombin time, activated partial thromboplastin time, fibrinogen, D-dimer, interleukin 6, interleukin 8, interleukin 10, interleukin 2 receptor, tumor necrosis factor-α, troponin I, phosphokinase isoenzyme-MB, and B-type natriuretic peptide; and decreased platelets, lymphocyte absolute value, and eosinophil absolute value ($P<0.05$). There were 45 patients who died in ICU and 57 improved and discharged patients. There were significant differences between the two groups in the number of patients that had 1 complication and 3 or more complications ($P<0.05$). There were also significant differences in the laboratory examination results between the patients including elevated urea nitrogen, total bilirubin, direct bilirubin, aspartate aminotransferase, procalcitonin, white blood cells, interleukin 8, interleukin 10, phosphokinase isoenzyme-MB, and B-type natriuretic peptide; and decreased platelets and eosinophil absolute value ($P<0.05$).

Conclusions: Our findings highlight that the identified determinants may help to improve treatment of COVID-19 patients, to predict the risk of developing severe illness and to optimizing arrangement of health resources.

Keywords: Novel coronavirus 2019 (COVID-19); ICU; general wards; clinical characteristics; laboratory examination

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Introduction

The COVID-19 disease was highly contagious, had a high mortality rate, and its clinical manifestations were very similar to those of viral pneumonia (1). The pathogen of this disease has since been confirmed as a novel form of coronavirus (2,3), which is phylogenetically similar to the severe acute respiratory syndrome coronavirus (SARS-CoV) (4). The World Health Organization (WHO) officially named it novel 2019 coronavirus (COVID-19), with the pathogen being named the COVID-19 virus. The COVID-19 disease manifests as asymptomatic infection or mild-to-severe pneumonia. The general clinical symptoms are fever, cough, fatigue, shortness of breath, and chest tightness (5,6), with digestive symptoms, such as diarrhea, being less frequent (7). The results of laboratory tests also suggested decreased lymphocytes and increased serum cytokines to be possible indicators (8). We gathered and compared the differences between the data of patients in the ICU wards and general wards of Leishenshan Hospital, a designated COVID-19 center. We also compared the differences between patients who died in the ICU wards and those who recovered and were discharged from the ICU. Through this analysis, we hope to provide valuable insights into the prevention, treatment, and possible prognostic trends of COVID-19 infection.

We present the following article in accordance with the STROBE reporting checklist (available at http://dx.doi.org/10.21037/apm-21-25).

Methods

Study design and participants

This study retrospectively analyzed 251 patients with confirmed COVID-19 infection who were admitted to Leishenshan Hospital from February 21, 2020 to April 14, 2020. Of these patients, 137 patients were admitted to ICU wards: 45 of these patients died during hospitalization, 57 recovered were discharged, and 33 were still hospitalized by the end of the observation period. Meanwhile, 114 of the enrolled patients were admitted to the general negative pressure wards.

The COVID-19 patients included in this study were clinically stratified into mild, moderate, severe, and critical groups according the national protocols at the time (9). Patients who met any of the following criteria were diagnosed as severe cases: (I) shortness of breath, respiratory rate (RR) ≥30 beats/min; (II) oxygen saturation, ≤93% (under rest); (III) $PaO_2/(FiO_2)$ <300 mmHg or lung imaging showing significant progression of lesions (>50%) within 24–48 hours Patients who met any of the following criteria were diagnosed as critical cases: (I) respiratory failure, requiring mechanical ventilation; (II) shock; (III) other organ failure combined with the need for ICU monitoring and treatment (9). All patients in the critical group and some patients in the severe group whose symptoms had worsened were admitted to the ICU wards; the other patients were admitted to the general negative pressure wards. Patients with missing data were excluded. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by the Ethics Committees of Shanghai Fifth People's Hospital [No. (2020 EC (170)] and the individual informed consent was waived due to the retrospective analysis.

Data collection

The patient data were retrieved from the electronic medical record system, and general information including gender, age, time from onset to admission to Leishenshan hospital, fever, cough, fatigue, chest tightness, shortness of breath, diarrhea, and past comorbidities, [including hypertension, coronary heart disease, diabetes, uremia, cerebral hemorrhage, cerebral infarction, cirrhosis, malignant tumor, severe anemia, chronic obstructive pulmonary disease (COPD), asthma, and Alzheimer's disease] were collected. The following results from the first laboratory test after initial hospitalization (blood tests were usually taken on the day of admission or the next day) were collected: blood urea nitrogen (BUN), creatinine (Cr), total bilirubin

Table 1 Comparison of the demographic and clinical characteristics of patients in the general ward and ICU ward

Variable	ICU patients (n, 135)	General ward patients (n, 114)	P value
Age, yrs (mean ± SD) Age range	69.57±12.41 (31–93)	60.98±15.25 (15–93)	<0.001
Sex, n (%)			0.014
Male	92 (68.1)	60 (52.6)	
Female	43(31.9)	54 (47.4)	
Time from onset to admission, days, mean ± SD [time range]	17.09±14.21 [1–60]	19.57±15.81 [1–50]	0.298
Fever, n (%)	130 (96.3)	92 (80.7)	<0.001
Cough, n (%)	98 (72.59)	79 (69.3)	0.578
Fatigue, n (%)	70 (51.85)	47 (41.22)	0.099
Chest tightness, n (%)	31 (22.96)	21 (18.42)	0.435
Shortness of breath, n (%)	116 (85.93)	43 (37.72)	<0.001
Diarrhea, n (%)	3 (2.22)	5 (4.39)	0.475
Patients with no previous complications, n (%)	6 (4.44)	26 (22.81)	<0.001
Patients with 1 complication, n (%)	19 (14.07)	45 (39.47)	<0.001
Patients with 2 complications, n (%)	42 (31.11)	28 (24.56)	0.262
Patients with 3 or more complications, n (%)	68 (50.37)	15 (13.16)	<0.001

Data are expressed a mean ± SD or n (%). P value denotes the comparison between the ICU case group the and general ward case group.

(TBIL), direct bilirubin (DBIL), aspartate aminotransferase (AST), alanine aminotransferase (ALT), total protein (TP), albumin (ALB), creatine kinase (CK), lactate dehydrogenase (LDH), procalcitonin (PCT), blood sedimentation (ESR), white blood cells (WBC), platelet (PLT), lymphocyte absolute value (LYM), neutrophil absolute value (NEUT), eosinophil absolute value (EOS), monocyte absolute value (MONO), C-reactive protein (CRP), prothrombin time (PT), activated partial thromboplastin time (APTT), fibrinogen (FIB), thrombin time (TT), D dimer (D-D), interleukin-1 beta (IL-1β), interleuki-6 (IL-6), interleukin-8 (IL-8), interleukin-10 (IL-10), interleukin-2 receptor (IL-2R), tumor necrosis factor alpha (TNF-α), troponin I (TNI), creatine kinase-MB (CK-MB), and B type natriuretic peptide (BNP).

Statistical analysis

Continuous variables are expressed as the mean ± standard deviation (SD), and between-group comparisons were performed using an independent samples *t*-test. Categorical variables are presented as frequency and proportions, and were analyzed for differences using a chi-squared test. All statistical analyses were conducted using SAS software v.9.4 (SAS Institute Inc., Cary, NC, USA). All statistical tests were two-sided with the significance level being set at 5%.

Results

Comparison between the ICU and general ward patients

There were 114 patients in the general ward and 135 patients in the ICU. The demographic and clinical characteristics of patients in the general ward compared to those in the ICU ward are shown in *Table 1*. On average, the ICU patients were older than the patients in the general wards (P<0.05). The ratio of males to females was 2.14:1 and 1.11:1 in the ICU and general wards, respectively, which was a significant difference (P<0.05). The proportions of patients with fever and shortness of breath in the ICU ward were significantly higher than those in the general ward (P<0.05). The proportions of patients in the general ward with no previous complications and 1 complication were significantly higher than those in the ICU group, while the proportion of patients with 3 or more complications was significantly lower than that in the ICU group (P<0.05).

The laboratory findings at admission are shown in *Table 2*. The proportions of patients in the ICU who had

Table 2 Comparison of abnormal laboratory findings of the patients in the ICU ward and general wards

Variable	ICU patients (n=135)	General ward patients (n=114)	Normal range	P value
BUN >7.6 mmol/L	62/113 (54.87%)	10/112 (8.93%)	2.8–7.6 mmol/L	<0.001
Cr >104 μmol/L	31/113 (27.43%)	5/112 (4.46%)	64–104 μmol/L	<0.001
TBIL >21 μmol/L	11/120 (9.17%)	3/112 (2.68%)	5–21 μmol/L	0.052
DBIL >7 μmol/L	37/120 (30.83%)	6/112 (5.36%)	0–7 μmol/L	<0.001
AST >40 U/L	33/133 (24.81%)	13/112 (11.61%)	15–40 U/L	0.009
ALT >50 U/L	28/133 (21.05%)	17/112 (15.18%)	9–50 U/L	0.251
TP <65 g/L	103/123 (83.74%)	46/112 (41.07%)	65–85 g/L	<0.001
ALB <40 g/L	118/123 (95.93%)	83/112 (74.11%)	40–55 g/L	<0.001
CK >171 IU/L	19/119 (15.97%)	6/112 (5.36%)	0–171 IU/L	0.011
LDH >243 IU/L	87/119 (73.11%)	18/112 (16.07%)	125–243 IU/L	<0.001
PCT >0.05 ng/mL	121/128 (94.53%)	26/87 (29.89%)	0–0.05 ng/mL	<0.001
ESR >20 mm/h	58/76 (76.32%)	47/89 (52.81%)	0–20 mm/h	0.002
WBC $<3.5\times10^9$/L	5/131 (3.82)	2/106 (1.89%)	$(3.5–9.5)\times10^9$/L	0.465
WBC $>9.5\times10^9$/L	48/131 (36.64%)	15/106 (14.15%)	$(3.5–9.5)\times10^9$/L	<0.001
PLT $<125\times10^9$/L	28/131 (21.37%)	5/112 (4.46%)	$(125–350)\times10^9$/L	<0.001
PLT $>350\times10^9$/L	18/131 (13.74%)	7/112 (6.25%)	$(125–350)\times10^9$/L	0.060
LYM $<1.1\times10^9$/L	91/131 (69.47%)	27/112 (24.11%)	$(1.1–3.2)\times10^9$/L	<0.001
NEUT $<1.8\times10^9$/L	5/131 (3.82%)	7/112 (6.25%)	$(1.8–6.3)\times10^9$/L	0.554
MONO $<0.1\times10^9$/L	1/131 (0.76%)	0/112 (0%)	$(0.1–0.6)\times10^9$/L	1.000
EOS $<0.02\times10^9$/L	51/131 (38.93%)	9/112 (8.04%)	$(0.02–0.52)\times10^9$/L	<0.001
CRP >4 mg/L	90/105 (85.71%)	30/99 (30.30%)	0–4 mg/L	<0.001
PT >13 s	40/119 (33.61%)	7/106 (6.60%)	9–13 s	<0.001
APTT >40 s	34/119 (28.57%)	3/106 (2.83%)	20–40 s	<0.001
FIB >4 g/L	67/119 (56.30%)	19/106 (17.92%)	2–4 g/L	<0.001
TT >21 s	6/119 (5.04%)	1/106 (0.94%)	14–21 s	0.124
D-D >0.55 mg/L	122/126 (96.83%)	52/108 (48.15%)	0–0.55 mg/L	<0.001
IL-1β ≥5 pg/mL	16/61 (26.23%)	12/71 (16.90%)	<5 pg/mL	0.207
IL-6 >7 pg/mL	78/84 (92.86%)	20/83 (24.10%)	0–7 pg/mL	<0.001
IL-8 ≥62 pg/mL	13/61 (21.31%)	1/71 (1.41%)	<62 pg/mL	<0.001
IL-10 ≥9.1 pg/mL	17/61 (27.87%)	3/71 (4.23%)	<9.1 pg/mL	<0.001
IL-2R >710 U/mL	42/61 (68.85%)	11/71 (15.49%)	223–710 U/mL	<0.001
TNF-α ≥8.1 pg/mL	47/61 (77.05%)	24/71 (33.80%)	<8.1 pg/mL	<0.001
TNI >0.04 ng/mL	40/106 (37.74%)	2/92 (2.17%)	0–0.04 ng/mL	<0.001
CK-MB >6.36 ng/mL	10/106 (9.43%)	1/92 (1.09%)	0–6.36 ng/mL	0.012
BNP >100 pg/mL	72/115 (62.61%)	8/98 (8.16%)	0–100 pg/mL	<0.001

P value denotes the comparison between the ICU case group and general ward case group. BUN, blood urea nitrogen; Cr, creatinine; TBIL, total bilirubin; DBIL, direct bilirubin; AST, aspartate aminotransferase; ALT, alanine aminotransferase; TP, total protein; ALB, albumin; CK, creatine kinase; LDH, lactate dehydrogenase; PCT, procalcitonin; ESR, blood sedimentation; WBC, white blood cells; PLT, platelet; LYM, lymphocyte absolute value; NEUT, neutrophil absolute value; MONO, monocyte absolute value; EOS, eosinophil absolute value; CRP, C-reactive protein; PT, prothrombin time; APTT, activated partial thromboplastin time; FIB, fibrinogen; TT, thrombin time; D-D, D dimer; IL-1β, interleukin-1 beta; IL-6, interleuki-6; IL-8, interleukin-8; IL-10, interleukin-10; IL-2R, interleukin-2 receptor; TNF-α, tumor necrosis factor alpha; TNI , troponin I; CK-MB, creatine kinase-MB; BNP, B type natriuretic peptide.

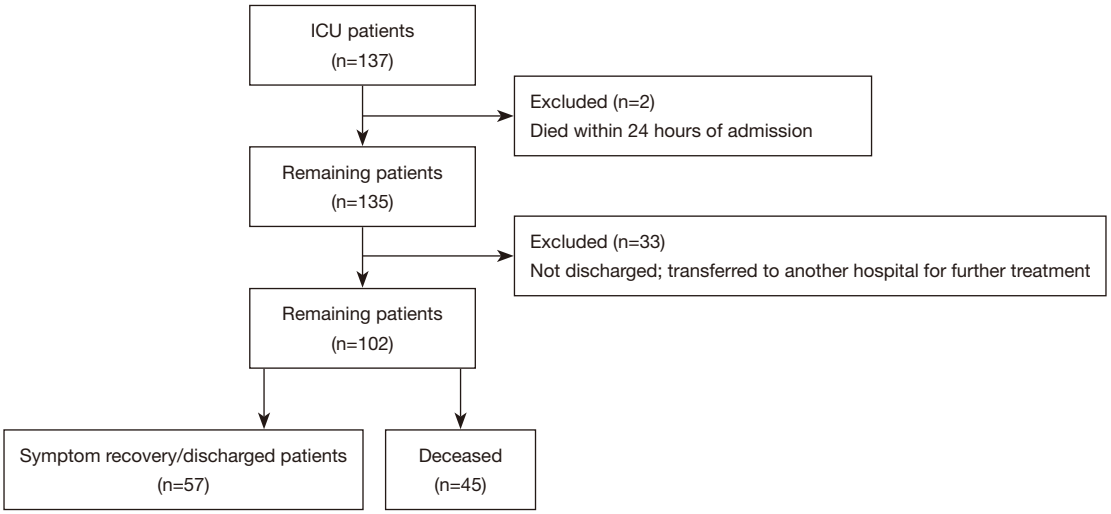

Figure 1 Enrollment and outcomes.

elevated BUN, Cr, DBIL, AST, TP, ALB, CK, LDH, PCT, ESR, WBC, CRP, PT, APTT, FIB, D-D, IL-6, IL-8, IL-10, IL-2R, TNF-α, TNI, CK-Mb, and BNP were higher those of the patients in the general wards (P<0.05), while the proportions of patients in the ICU who had decreased PLT, LYM, and EOS were higher than those of patients the in the general wards (P<0.05).

Comparison between deceased patients and discharged patients of the ICU ward

The differences between 45 deceased patients (ICU admission for at least 24 hours and died in ICU) and 57 discharged patients in the ICU ward were analyzed, as shown in *Figure 1*. The demographic and clinical characteristics of the patients in these two group are shown in *Table 3*; compared with discharged patients, the deceased patients were significantly older (P<0.05); and the proportion of patients with 3 or more complications in the deceased group was significantly higher (P<0.05); however, there was no significant difference between the two groups in terms of sex, fever, cough, and other symptoms. As was shown in *Table 4*, the proportions of patients in death group who had elevated BUN, TBIL, DBIL, AST, PCT, ESR, WBC, IL-8, IL-10, CK-Mb, and BNP, and decreased PLT and EOS, were higher than those in the discharged group (P<0.05).

Discussion

COVID-19 has been characterized as an epidemic disease with high mortality. Therefore, a comprehensive analysis of the patients' epidemiology, laboratory results, clinical symptoms, and imaging results is helpful for the early prevention, diagnosis, and treatment of this disease (10). Indeed, previous studies have demonstrated that comparing the demographic characteristics, clinical manifestations, and laboratory indicators of severe and critical patients can substantively inform prognostic evaluation (7,11). The COVID-19 patients admitted to the ICU ward had certain indications: only patients in the critical group and some patients in severe group whose symptoms had worsened were admitted to the ICU. We compared the ICU patients with the general ward patients, seeking to identify any differences in population characteristics, clinical manifestations, and laboratory indicators between critical patients in ICU and moderate patients with good prognosis in general ward. We also compared the differences between the discharged and deceased patients who had been admitted to the ICU. By comparing the different prognoses of these critical patients coming from ICU, we can further clarify the significance of these indicators and factors in disease severity and outcome.

We collected the baseline data of patients in the ICU ward and in the general wards in Wuhan Leishenshan Hospital for multi-factor comparison. We found that the average age of the ICU patients was higher than that of the general ward patients, which we interpreted to be a consequence of the COVID-19 disease tending to become more critical in elderly patients. The incidence of fever and shortness of breath in ICU patients was higher than those

Table 3 Comparison of the demographic and clinical characteristics of the deceased patients and discharged patients in the ICU ward

Variable	Dead (n=45)	Discharged (n=57)	P value
Age, years (mean ± SD)	72.49±11.42	66.23±11.85	0.008
Sex, n (%)			0.097
Male	26 (57.8)	42 (73.7)	
Female	19 (42.2)	15 (26.3)	
Fever, n (%)	44 (97.78)	54 (94.74)	0.628
Cough, n (%)	34 (75.56)	40 (71.93)	0.656
Fatigue, n (%)	25 (55.56)	28 (49.12)	0.554
Chest tightness, n (%)	11 (24.44)	12 (21.05)	0.812
Shortness of breath, n (%)	40 (88.89)	47 (82.46)	0.412
Diarrhea, n (%)	1 (2.22)	2 (3.51)	1.000
Patients with no previous complications, n (%)	0 (0)	4 (7.02)	0.128
Patients with one complication, n (%)	2 (4.44)	13 (22.81)	0.011
Patients with two complications, n (%)	12 (26.67)	23 (40.35)	0.208
Patients with three or more complications, n (%)	31 (68.89)	17 (29.82)	<0.001

Data are mean ± SD or n (%). P value denotes the comparison between the deceased cased group and the discharged case group.

in general wards, while there was no significant difference in symptoms such as cough, fatigue, chest tightness, or and diarrhea between the two groups (P>0.05). In terms of comorbidities, we found that the proportion of ICU patients with 3 or more comorbidities was significantly higher than that of the general ward patients (50.37% *vs.* 13.16%, P<0.05); in contrast, the proportion of patients in the general ward who had no comorbidities or only 1 comorbidity was higher than that of patients in the ICU (P<0.05). We believe this to be explainable by the fact that patients with an already weaker condition and more comorbidities were more likely to deteriorate in condition.

We found that the proportions of elevated BUN, Cr, DBIL, AST, CK, LDH, TNI, CK-MB and BNP in ICU patients were higher than those in general ward patients the (P<0.05). This is consistent with previous studies reporting that the COVID-19 virus can damage the liver, renal function, and myocardial cells (12-15), with this damage being more likely to be occur in critical patients. The proportions of elevated inflammatory factors such as CRP, PCT, IL-6, IL-8, IL-10, IL-2R, and TNF-αin ICU patients was significantly higher than those of the general ward patients (P<0.05). Furthermore, the proportions of elevated PT, APTT, FIB, and D-D in the ICU patients were significantly higher than those in the general ward patients (P<0.05). This was consistent with previous reports indicating that COVID-19 can damage coagulation function (16,17), with this damage being more common in critically ill patients. We also found that the proportions of increased WBC, decreased PLT, decreased LYM, decreased EOS, decreased TP, and decreased ALB in the ICU patients were significantly higher compared with those in the general ward patients (P<0.05). A possible reason for the TP and ALB decreases in ICU patients was malnutrition and excessive consumption. The proportion of critical patients with increased ESR in the ICU patients was also significantly higher than that of the general ward patients (P<0.05).

The average age of ICU patients in the deceased group was greater than that in the discharge group (P<0.05), and the proportion of patients in the deceased group with 3 or more previous comorbidities was significantly higher than that in the discharge group (P<0.05), suggesting that age and comorbidities not only affect the course of disease, but are also related to the prognosis of death. There were no significant differences between the deceased and discharged patients of the ICU ward in terms of the proportion of Cr, TP, ALB, CK, LDH, CRP, PT, APTT, FIB, D-D, IL-6, IL-2R, TNF-α, and TNI, or decreased LYM. Meanwhile, a significant difference in TBIL was found between the deceased and discharged patients of the ICU ward (P<0.05);

Table 4 Abnormal laboratory findings of the death and symptoms recovery discharged patients in ICU ward

Variable	Deceased (n=45)	Discharged (n=57)	Normal range	P value
BUN >7.6 mmol/L	32/39 (82.05%)	17/49 (34.69%)	2.8–7.6 mmol/L	<0.001
Cr >104 mmol/L	17/39 (43.59%)	12/49 (24.49%)	64–104 μmol/	0.071
TBIL >21 mmol/L	9/41 (21.95%)	1/52 (1.92%)	5–21 μmol/L	0.004
DBIL >7 mmol/L	20/41 (48.78%)	7/52 (13.46%)	0–7 μmol/L	<0.001
AST >40 U/L	20/44 (45.45%)	10/56 (17.86%)	15–40 U/L	0.004
ALT >50 U/L	13/44 (29.55%)	10/56 (17.86%)	9–50 U/L	0.232
TP <65 g/L	40/44 (90.91%)	45/54 (83.33%)	65–85 g/L	0.373
ALB < 40g/L	44/44 (100%)	52/55 (94.55%)	40–55 g/L	0.252
CK >171 μ/L	8/34 (23.53%)	4/51 (7.84%)	0–171 IU/L	0.058
LDH >243 μ/L	30/40 (75%)	33/51 (64.71%)	125–243 IU/L	0.362
PCT >0.05 ng/mL	43/44 (97.73%)	43/51 (84.31%)	0–0.05 ng/mL	0.035
ESR >20 mm/h	20/26 (76.92%)	31/39 (79.49%)	0–20 mm/h	1.0
WBC <3.5×10^9/L	3/44 (6.82%)	2/55 (3.64%)	(3.5–9.5)×10^9/L	0.653
WBC >9.5×10^9/L	25/44 (56.82%)	10/55 (18.18%)	(3.5–9.5)×10^9/L	<0.001
PLT <125×10^9/L	17/44 (38.64%)	3/55 (5.45%)	(125–350)×10^9/L	<0.001
PLT >350×10^9/L	10/44 (22.72%)	6/55 (10.91%)	(125–350)×10^9/L	0.169
LYM <1.1×10^9/L	37/44 (84.09%)	37/55 (67.27%)	(1.1–3.2)×10^9/L	0.066
NEUT <1.8×10^9/L	1/44 (2.27%)	1/55 (1.82%)	(1.8–6.3)×10^9/L	1.0
MONO <0.1×10^9/L	2/43 (4.65%)	0/55 (0%)	(0.1–0.6)×10^9/L	0.190
EOS <0.02×10^9/L	24/40 (60%)	15/51 (29.41%)	(0.02–0.52)×10^9/L	0.005
CRP >4 mg/L	30/31 (96.77%)	39/48 (81.25%)	0–4 mg/L	0.079
PT >13 s	14/40 (35%)	20/52 (38.46%)	9–13 s	0.829
APTT >40 s	13/40 (32.5%)	13/52 (25%)	20–40 s	0.488
FIB >4 g/L	23/40 (57.5%)	36/52 (69.23%)	2–4 g/L	0.278
TT >21 s	4/40 (10%)	1/52 (1.92%)	14–21 s	0.163
D-D >0.55 mg/L	43/44 (97.73%)	50/53 (94.34%)	0–0.55 mg/L	0.624
IL-1β ≥5 pg/mL	5/17 (29.41%)	6/32 (18.18%)	<5 pg/mL	0.48
IL-6 >7 pg/mL	24/25 (96%)	36/41 (87.8%)	0–7 pg/mL	0.396
IL-8 ≥62 pg/mL	5/17 (29.41%)	2/32 (6.25%)	<62 pg/mL	0.041
IL-10 ≥9.1 pg/mL	7/17 (41.18%)	2/32 (6.25%)	<9.1 pg/mL	0.005
IL-2R >710 μ/mL	12/16 (75%)	20/32 (62.5%)	223–710 U/mL	0.521
TNF-α ≥8.1 pg/mL	13/15 (86.67%)	21/32 (65.63%)	<8.1 pg/mL	0.175
TNI >0.04 ng/mL	20/41 (48.78%)	18/46 (39.13%)	0–0.04 ng/mL	0.394
CK-MB >6.36 ng/mL	9/41 (21.95%)	0/46 (0%)	0–6.36 ng/mL	0.001
BNP >100 pg/mL	31/41 (75.61%)	25/48 (52.08%)	0–100 pg/mL	0.028

P value denotes the comparison between the deceased case group and the discharged case group. BUN, blood urea nitrogen; Cr, creatinine; TBIL, total bilirubin; DBIL, direct bilirubin; AST, aspartate aminotransferase; ALT, alanine aminotransferase; TP, total protein; ALB, albumin; CK, creatine kinase; LDH, lactate dehydrogenase; PCT, procalcitonin; ESR, blood sedimentation; WBC, white blood cells; PLT, platelet; LYM, lymphocyte absolute value; NEUT, neutrophil absolute value; MONO, monocyte absolute value; EOS, eosinophil absolute value; CRP, C-reactive protein; PT, prothrombin time; APTT, activated partial thromboplastin time; FIB, fibrinogen; TT, thrombin time; D-D, D dimer; IL-1β, interleukin-1 beta; IL-6, interleuki-6; IL-8, interleukin-8; IL-10, interleukin-10; IL-2R, interleukin-2 receptor; TNF-α, tumor necrosis factor alpha; TNI , troponin I; CK-MB, creatine kinase-MB; BNP, B type natriuretic peptide.

but TBIL was not significantly different between ICU ward patients and general ward patients.

COVID-19, similar to SARS-CoV, is reported to act primarily on lymphocytes, especially T lymphocytes. Thus, lymphopenia could be used as a reference in the diagnosis of novel coronavirus infection (18-20). In our study, the proportion of patients with decreased LYM in ICU wards was significantly higher than that in patients in the general wards ($P<0.05$), but there was no significant difference in decreased LYM between the deceased patients and the discharged patients in the ICU wards ($P>0.05$). A possible reason for this was that only the LYM level at the time of admission was analyzed, and the dynamic LYM changes were not observed. In addition, the proportion of patients in the ICU ward with decreased EOS was higher than that of patients in the general ward ($P<0.05$), and it was higher in the deceased patients than in the discharged patients ($P<0.05$). We therefore speculated that COVID-19 may also have a significant impact on EOS, and this warrants further study. Coronavirus has also been reported to cause an inflammatory storm (21,22) and damage the heart muscle; indeed, we found that the proportions of ICU patients with abnormal cardiac injury factors such as TNI, CK-MB, and BNP were higher than those of patients in the general wards. However, the levels of these factors were usually only slightly increased, and the specific reasons for this need to be further investigated.

Our study has some limitations that should also be addressed. First, this was a retrospective case control study from a single center, and was thus subject to recall and selection bias. Second, the generalizability of the study results might be limited by its smaller sample size, and validation based on a larger sample of patients is necessary.

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Footnote

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Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by the Ethics Committees of Shanghai Fifth People's Hospital [No. (2020 EC (170)] and the individual informed consent was waived due to the retrospective analysis..

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