CLINICAL CHARACTERISTICS OF DEATH AND RECOVERED CASES OF COVID-19 PATIENTS WITH ENDOTRACHEAL INTUBATION

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ABSTRACT

Introduction*: To investigate the clinical characteristics of endotracheal intubation patients who died or recovered from coronavirus disease 2019 (COVID-19) and factors related to death or recovery.*

Materials and methods*: A total of 126 patients diagnosed with COVID-19 with endotracheal intubation were included in this study. Personal information, laboratory tests, imaging studies, and clinical data were collected to analyze the clinical characteristics of endotracheal intubation patients who died or recovered from COVID-19.*

Results*: 1. A significantly higher proportion of patients in the death group received antibiotic therapy and glucocorticoid dosage than those in the recovery group (P<0.05). The time from admission to intubation and complications after intubation was significantly longer in the death group than in the recovery group (P<0.05). The proportion of use Extracorporeal Membrane Oxygenation(ECMO) was significantly lower in the death group than in the recovery group (P<0.05). 2. The patients in 3the death group were significantly older, and a significantly higher proportion of the patients in the death group than in the recovery group were men or were smokers (P<0.05). The comorbidities and proportion of post-intubation infection was significantly higher in the death group than in the recovery group (P<0.05). The admission time was significantly earlier in the death group than in the recovery group (P<0.05). 3. There was more pronounced in the death group in terms of both the proportion of patients with this symptom and its severity (P<0.05). The blood oxygen saturation level was significantly lower and the respiratory rate was significantly higher in the death group than in the recovery group (P<0.05). 4. Pretreatment (at admission) white blood cells, neutrophils, D-dimers, aspartate aminotransferase, procalcitonin, and C-reactive protein and posttreatment white blood cells, neutrophils, aspartate aminotransferase, creatinine, erythrocyte sedimentation rate, procalcitonin, and C-reactive protein were significantly higher in the death group than in the recovery group (P<0.05). Pretreatment lymphocytes, albumin, and oxygen partial pressure and posttreatment albumin and oxygen partial pressure were significantly lower in the death group than in the recovery group (P<0.05). Laboratory tests showed that in the recovery group, white blood cells, lymphocytes, neutrophils, and platelets were significantly increased after treatment, and aspartate aminotransferase and C-reactive protein were significantly decreased after treatment (P<0.05). White blood cells, neutrophils, BNP and platelets were also significantly increased after treatment in the death group (P<0.05).*

Conclusion*: Advanced age, smoking, high fever, time from admission to intubation, ECMO, complications and infection after intubation, rapid respiratory rate, low oxygen saturation are adverse prognostic factors.*

Keywords: *COVID-19, endotracheal intubation, death, recovery.*

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Introduction

On February 11, 2020, the International Committee on Taxonomy of Viruses (ICTV) officially named the novel coronavirus severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). Available data indicate that the mortality of SARS-CoV-2 infection is lower than that of severe acute respiratory syndrome (SARS)[(1)] and Middle Eastern Respiratory Syndrome (MERS)[(2)]. Nevertheless, SARS-CoV-2 causes acute respiratory disease, which is highly infectious, easily spread, and prone to cause critical conditions, approximately 8% will require endotracheal intubation and mechanical ventilation. The severity of the initial symptoms varies from patient to patient[(3)], the illness of endotracheal intu-

bation patient may change rapidly, making it very difficult to predict the disease outcome in an accurate and timely manner. Currently, it is critical to improve the endotracheal intubation patients recovery rate and reduce mortality.

Methods

Subjects

A total of 126 endotracheal intubation patients admitted to The TongJi Hospital of Wuhan and diagnosed with SARS-COV-2 infection between December 2019 and February 28, 2000, were included in this study. As of March 20, 2020, 50 had died and 76 met discharge criteria and were discharged.

Inclusion criteria:

• SARS-COV-2 cases confirmed in accordance with the Novel Coronavirus Pneumonia Diagnosis and Treatment Plan (Provisional 5th Edition)) by novel coronavirus nucleic acid test with real-time fluorescent reverse transcription polymerase chain reaction (RT-PCR) or virus gene sequencing using respiratory or blood samples showing a high level of homology with known novel coronaviruses;

• death or recovery.

Death was defined as COVID-19-related death during hospitalization. Recovery was defined according to the discharge criteria in the Novel Coronavirus Pneumonia Diagnosis and Treatment Plan (Provisional 7th Edition), which include a normal temperature for 3 days or more, significant improvement in respiratory symptoms, chest imaging studies suggesting significant absorption of inflammation, and two consecutive negative nucleic acid tests for respiratory pathogens (with at least one day between sample collections).

Data collection

All 126 endotracheal intubation patients were diagnosed with SARS-COV-2 infection with real-time fluorescence RT-PCR of nasopharyngeal swabs or alveolar lavage fluid. We focused on the clinical characteristics of the death and recovery cases. We collected general information, including sex, age, epidemiological history, smoking history, and comorbidities (chronic obstructive pulmonary disease, malignant tumor, hypertension, diabetes, coronary heart disease, or other conditions), and clinical data, including initial symptom(s), time from the onset of symptoms to the initial visit), treatment duration, vital signs, medications, infection condition, time from admission to intubation and disease outcomes.

Laboratory tests were performed within 3 days of admission and after treatment (3 days prior to discharge/death). They included blood tests (white blood cells, lymphocytes, neutrophils, platelets, Cardiac troponin T (cTnT); Brain natriuretic peptide (BNP), hemoglobin, lymphocyte/white blood cell ratio (LWR), neutrophil/lymphocyte ratio (NLR), lymphocyte/monocyte ratio (LMR), platelet/ lymphocyte ratio (PLR)), liver and kidney function (alanine aminotransferase, aspartate aminotransferase, total bilirubin, urea, albumin, lactate dehydrogenase), infection markers (procalcitonin, C-reactive protein, D-dimers), and oxygen partial pressure.

Data analysis

GraphPad Prism 8.0 was used for the statistical analysis. Count data are expressed as frequency and percent and analyzed with a c2 test. Normally distributed measurement data are expressed as $\bar{x} \pm s$ and analyzed with t-tests. $P<0.05$ was considered statistically significant.

Results

Treatment and disease outcomes

All 126 endotracheal intubation patients with SARS-COV-2 infection received anti-viral therapy, with ribavirin as the most common treatment (106 (84.1%)). In addition, 97 patients (77%) received antibiotic therapy, 84 (66.7%) received systemic glucocorticoids, 3 (2.4%) received interferon therapy, 53 (42%) received human γ-immunoglobulin, and 26 (20.6%) received thymosin. As of March 20, 2020, 50 patients died in the hospital (the death group), and 76 met the discharge criteria and were discharged (the recovery group). An analysis of their treatment plans showed no significant between-group difference in the type of antiviral drugs used or in the use of interferon therapy, human γ-immunoglobulin, or thymosin ($P>0.05$).

A significantly higher proportion of patients in the death group than those in the recovery group received antibiotic therapy ($P<0.05$), suggesting that bacterial infection was more common in the death group, which may have contributed to the disease progression. The glucocorticoids dosage was significantly higher in the death group than in the recovery group ($P<0.05$). The time from admission to intubation was significantly longer in the death group than in the recovery group ($P<0.05$). The proportion of use ECMO was significantly lower in the death group than in the recovery group ($P<0.05$).

The complications after intubation was significantly higher in the death group than in the recovery group (P<0.05) (Table 1).

	Total (N=126)	Recovery (n=76)	Death (n=50)	P
Antiviral therapy	126/126(100%)			0.551
Ribavirin	106(84.1%)	93	13	
Oseltamivir	11(8.7%)	8	3	
Traditional Chinese medicine	9(7.1%)	8	1	
Lopinavir	10(7.9%)	9	1	
Antibiotic therapy	97 (77%)	79	13	0.021
Quinolones	27(21.4%)	25	2	
Cephalosporin/penicillin	63(50.0%)	53	10	
Carbapenems/linezolid	15(11.9%)	1	1	
Glucocorticoid dosage (mg/d)	84/126(66.7%)			0.016
≤20	22(17.5%)	22	0	
21-40	54(42.9%)	48	6	
41-60	1(0.8%)	1	0	
>60	7(5.6%)	4	3	
Interferon				0.185
Yes	3(2.4%)	2	1	
No	123(97.6%)	111	12	
Human γ-immunoglobulin				0.143
Yes	53(42%)	50	3	
No	73(58%)	63	10	
Thymosin				0.223
Yes	26(20.6%)	25	1	
No	100(79.4%)	88	12	
Time from admission to intubation(day)				0.015
<7	21(16.7%)	13	8	
7-10	58(46.0%)	47	11	
>10	47(37.3%)	26	21	
ECMO	15(11.9%)	12	3	0.046
Complications after intubation	57(45.2%)_	28	29	0.019

Table 1: SARS-CoV-2 Treatment and disease outcomes.
Data are expressed as n (%) or n/n (%), where n is the total case number for the relevant item.

General information

The 126 endotracheal intubation patients had an average age of 46.53 years (recovery group: 47.85; death group: 68.15, male: female = 2.25: 1). The death group was significantly older, with a significantly higher proportion of male patients and smokers than in the recovery group (P<0.05). Among the 126 endotracheal intubation patients in the death group and the recovery group, Fifty-four of the 126 endotracheal intubation patients (42.9%) had comorbidities such as chronic obstructive pulmonary disease, malignant tumor, hypertension, diabetes, or coronary heart disease, the comorbidities was significantly higher in the death group than in the recovery group (P<0.05).48(38.1%) patients admission time was December or January, the admission time was significantly earlier in the death group than in the recovery group (P<0.05). the proportion of post-intubation infection was significantly higher in the death group than in the recovery group (P<0.05) (Table 2).

Clinical manifestation

For the 126 endotracheal intubation patients, the median time between onset of symptoms and the initial visit was 6.65 days, and mean treatment time period was 19.28 days; there was no significant difference in treatment time between the death group and the recovery group. Fever was the most common initial symptom of SARS-COV-2 infection. Ninety-two patients (73%) visited our hospital for fever, which was up to 37.3°C to 38°C in 45 patients. Fever rate and fever grade were significantly higher in the death group than those in the recovery group (P < 0.05).

	Total (N=126)	Recovery (n=76)	Death (n=50)	P
Age	46.53	47.85±23.12	68.15±43.22	0.001
Sex				
Male	59(46.8%)	28	31	0.006
Female	67(53.2%)	48	19	
Smoking				
Yes	8(6.3%)	2	6	0.035
No	118(93.7%)	74	44	
Comorbidities				
Yes	54(42.9%)	28	26	0.016
No	72(57.1%)	48	24	
Admission time				0.001
December or January	48(38.1%)	19	29	
February	78(61.9%)	57	21	
Post-intubation infection	19(15.1%)	7	12	0.023
MRSA	5(4.0%)	1	4	
Klebsiella pneumoniae	3(2.4%)	0	3	
Acinetobacter baumannii	3(2.4%)	0	3	
Pseudomonas aeruginosa	2(1.6%)	1	1	

Table 2: Demographics and general characteristics of COVID-19 endotracheal intubation patients.
Data are expressed as n (%) or n/n (%), where n is the total case number of the relevant item. MRSA:Methicillin-resistant Staphylococcus Aureus

	Total (N=126)	Recovery (n=76)	Death (n=50)	P
Time between onset and initial visit (days)	6.65	6.72±3.34	6.3±2.43	0.751
Treatment duration (days)	19.28	18.8±2.76	21.5±3.34	0.236
Initial symptom				
Fever	92/126(73%)			0.011
<37.3 °C	31(24.6%)	31	0	
37.3 °C to 38 °C	45(35.7%)	42	3	
38.1 °C to 39 °C	35(27.8%)	28	7	
>39 °C	15(11.9%)	12	3	
Cough	51(40.5%)	45	6	0.659
Myalgia/fatigue	15(11.9%)	14	1	0.620
Difficulty breathing	11(8.7%)	9	2	0.369
Oxygen saturation (%)	94.8	95.6±4.32	87.1±15.76	0.001
Respiratory rate (breaths per min)	25.9	24.6±2.65	37.9±3.35	0.001
Heart rate (bpm)	93.8	94.8±6.43	98.8±7.78	0.541
Systolic blood pressure (mm/Hg)	123.8	123.9±43.56	122±56.43	0.841
Diastolic blood pressure (mm/Hg)	78.6	78.2±34.54	73.3±5.65	0.451
Lesion involvement on CT				0.144
Unilateral lung	26(20.6%)	26	0	
Bilateral lungs	100(79.4%)	87	13	

Table 3: Clinical manifestations of SARS-CoV-2 infection.
Data are expressed as n (%) or n/n (%), where n is the total number of cases of the relevant item

In addition to fever, other common COVID-19-related symptoms included cough, fatigue/myalgia, and difficulty breathing. For the 126 endotracheal intubation patients, oxygen saturation averaged 94.8%; the respiratory rate was high at admission in most cases and averaged 25.9 breaths per minute. The oxygen saturation level was significantly lower and the respiratory rate was significantly higher in the death group than that in the recovery

group (P<0.05). No significant difference in heart rate, blood pressure, or lesion involvement on CT was observed between the groups (P>0.05) Table 3).

Laboratory tests

Laboratory tests performed at admission (before treatment) and after treatment showed that pretreatment white blood cells, neutrophils, D-dimers, aspartate aminotransferase, procalcitonin, and C-reactive protein and posttreatment white blood cells, neutrophils, aspartate aminotransferase, creatinine, erythrocyte sedimentation rate, procalcitonin, and C-reactive protein were significantly higher in the death group than in the recovery group (P<0.05). Pretreatment lymphocytes, albumin, and oxygen partial pressure and posttreatment albumin and oxygen partial pressure were significantly lower in the death group than in the recovery group (P<0.05). Moreover, white blood cells, lymphocytes, neutrophils, and platelets were significantly increased after treatment, and aspartate aminotransferase and C-reactive protein were significantly decreased after treatment in the recovery group (P<0.05). White blood cells, neutrophils, BNP and platelets were also significantly increased after treatment in the death group (P<0.05) (Table 4).

	Recovery group (n=76)	Death group (n=50)	P
At admission			
White blood cells (10^9/L)	5.50±1.86	6.51±5.60	0.017
Lymphocytes (10^9/L)	1.08±0.51	0.57±0.58	0.011
Neutrophils (10^9/L)	3.77±1.87	9.62±4.77	0.003
Monocytes (10^9/L)	0.36±0.87	0.23±1.23	0.453
Platelets (10^9/L)	192±63.21	177.3±67.33	0.619
D-dimer	1.39±2.62	8.08±7.62	0.002
Albumin	40.67±5.28	32.8±3.10	0.001
Alanine aminotransferase	43.01±40.46	38.13±18.37	0.299
Aspartate aminotransferase	35.91±16.99	75.93±91.16	0.003
Creatinine	61.82±18.23	75.08±22.82	0.099
Erythrocyte sedimentation rate	41.42±30.63	59.25±64.42	0.497
Procalcitonin	0.09±0.38	0.31±0.37	0.001
C-reactive protein	2.48±2.43	7.69±3.70	0.001
Oxygen partial pressure (%)	88.58±38.21	55.2±15.92	0.013
cTnT	0.14(0.02,4.36)	0.26(0.04,5.44)	0.078
BNP	56.10±34.25	79.40±45.43	0.154
LWR	0.19±0.11	0.17±0.09	0.543
NLR	6.53±7.16	5.31±3.54	0.561
LMR	3.25±2.18	3.28±1.24	0.964
PLR	232.3±145.1	178.6±177.6	0.321
After treatment			
White blood cells (10^9/L)	9.36±34.08*	20.14±13.38*	0.001
Lymphocytes (10^9/L)	1.70±0.79***	0.83±0.98	0.930
Neutrophils (10^9/L)	5.28±3.69**	25.19±30.52*	0.001
Monocytes (10^9/L)	0.52±1.02	0.58±1.33	0.253
Platelets (10^9/L)	296.6±106.4****	210.6±119.6*	0.541
D-dimer	2.29±5.15	6.50±8.08	0.054
Albumin	38.08±4.83	32.73±3.74	0.012
Alanine aminotransferase	41.87±34.2	54.98±63.78	0.580
Aspartate aminotransferase	27.56±12.28*	45.65±45.04	0.033
Creatinine	61.35±18.05	94.61±92.5	0.036
Erythrocyte sedimentation rate	21.57±19.77	41.60±83.86	0.045
Procalcitonin	0.06±0.04	0.51±4.85	0.020
C-reactive protein	0.62±0.70**	9.54±18.81	0.003
Oxygen partial pressure (%)	109.15±36.82	32.33±4.57	0.001
cTnT	0.08(0.01,2.46)	0.19(0.02,3.56)	0.132
BNP	34.60±26.67	156.20±57.87	0.023
LWR	0.17±0.10	0.20±0.16	0.497
NLR	10.96±15.6	10.46±12.76	0.932
LMR	3.09±1.57	3.13±2.07	0.921
PLR	286.5±262.3	165.68±64.45	0.836

Table 4: Laboratory Tests of COVID-19 Endotracheal Intubation Patients ($\bar{x}$±s).
**P<0.05; ** P<0.01; ***P<0.001; ****P<0.0001 cTnT: Cardiac troponin T; BNP:Brain natriuretic peptide.*

Discussion

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) has been identified as the pathogen responsible for unexplained pneumonia(4). SARS-CoV-2 is genetically similar to a novel coronavirus in bats.(5) As with SARS-CoV and MERS-CoV, SARS-CoV-2 is a β coronavirus. SARS-CoV-2 nucleic acid tests may be positive with real-time fluorescent RT-PCR of respiratory tract specimens or blood samples from affected individuals. The virus has quickly spread around the world. Once an individual is infected with SARS-CoV-2, their condition progresses rapidly. Most severe cases develop difficulty breathing within a week, and critical cases can progress rapidly to acute respiratory distress syndrome, septic shock, uncontrolled metabolic acidosis, bleeding/coagulation disorders, and even death. In this study, we analyzed the clinical characteristics of endotracheal intubation patients death and recovery cases to determine the factors related to death and recovery in order to provide a theoretical basis for improving the treatment of endotracheal intubation COVID-19 patients and reducing mortality. A total of 126 endotracheal intubation patients with SARS-CoV-2 infection were included in this study. As of March 20, 2020, 50 died and 76 had met the discharge criteria and were discharged. The mean age of the patients in the recovery group was 47.85, compared to 68.15 in the death group, and the male-to-female ratio in the death group was 2.25:1. Age is an independent risk factor for many respiratory and circulatory diseases(6). This study showed that the endotracheal intubation patients in the death group were significantly older than those in the recovery group, and the death group had a significantly higher proportion of male patients (P<0.05). Elderly patients are susceptible to SARS-CoV-2 infection because of their weakened immunity, co-

morbidities, and cardiac and pulmonary dysfunction, which are also important prognostic factors[7]. The results show that the proportion of comorbidities after endotracheal intubation was significantly higher in the death group than in the recovery group (P<0.05). Endotracheal intubation is the most common invasive procedure in critically ill patients, the most common airway-related complications of such procedure maneuvers are infection, laryngotracheal granulomas, webs, stenosis, malacia and, less commonly, tracheal necrosis with tracheo-esophageal or tracheo-arterial fistulae[8].

This study showed that a significantly higher proportion of patients in the death group were smokers (P<0.05), suggesting that smoking is related to disease progression and is an adverse prognostic factor. The time period to initial visit was defined as the time from onset of symptoms to the initial hospital visit. the admission time was significantly earlier in the death group than in the recovery group (P<0.05),Xiao et.al findings may imply the decreases of virulence of the COVID-19 virus along with intergenerational transmission[9]. The proportion of post-intubation infection was significantly higher in the death group than in the recovery group (P<0.05), the most common infection is MRSA, the second common is klebsiella pneumoniae and acinetobacter baumannii. Infections especially with drug-resistant bacteria post-intubation infection means poor prognosis. Observations have shown that patients with more severe conditions and a rapid progression usually visit the hospital sooner, while those with less severe presentations wait longer. The time to initial visit is usually 4 to 8 days (median: 7)[10]

This report is consistent with the results of this study, which showed that for the 126 endotracheal intubation patients, the mean time to initial visit was 6.65 days, and the mean treatment duration was 19.28 days, with no significant difference between the death group and the recovery group (P>0.05). Most patients with COVID-19 had symptoms of hypoxia, which presented as hypoxemia in typical cases. For the 126 endotracheal intubation patients in this study, the mean respiratory rate was 25.9 breaths per minute, which was much higher than that in the normal population (12 to 20 breaths per minute). The oxygen saturation level was significantly lower and the respiratory rate was significantly higher in the death group than in the recovery group (P<0.05). These data suggest that a high respiratory rate[11], difficulty breathing, low oxygen saturation, and a poor response to oxygen therapy may indicate an adverse prognosis. Fever was the most common initial symptom of COVID-19. The fever grade varied from patient to patient, and the highest temperature reading was most frequently 37.3°C to 38°C. In the death group, the proportion of fever patients was significantly higher, and the fever patients in this group had higher temperatures than those in the recovery group (P<0.05), suggesting that close temperature monitoring may help in the assessment of patient conditions and the development of appropriate treatment plans.

COVID-19 progresses rapidly and causes systemic inflammatory responses, abnormal blood tests, coagulation disorders, cardiac, liver and kidney injury in addition to lung injury, resulting in a range of laboratory abnormalities. White blood cell count is a common indicator used to distinguish between bacterial infection and viral infection. In this study, laboratory tests performed at admission (before treatment) and after treatment showed that pretreatment lymphocyte counts were significantly lower in the death group than in the recovery group (P<0.05), which was consistent with Huang et al[10]. Lymphocytes were significantly increased after treatment in the recovery group (P<0.05). For patients with COVID-19, low lymphocyte counts are common, and the severity of patient condition was positively correlated with a decrease in lymphocytes. During infection, white blood cell counts usually increase; however, they may be significantly lower than normal in severe cases. In this study, the white blood cell count was significantly higher in the death group than in the recovery group both before and after treatment (P<0.05). Patients with COVID-19 usually require both antiviral therapy and steroid treatment, which greatly increases the chance of secondary bacterial infections.

In this study, white blood cell counts were significantly increased after treatment in both the death group and recovery group (P<0.05). The mean white blood cell count was 19.45×109/L after treatment in the death group, indicating secondary infections, which may be life-threatening. In contrast, a decrease in white blood cells after treatment may indicate improvement in patient conditions. Neutrophils are an important type of white blood cell. This study showed that both pretreatment and posttreatment neutrophil levels were significantly higher in the death group than in the recovery group (P<0.05). Moreover, neutrophil counts were significantly lower after treatment in the recovery group (P<0.05). It should be noted that white blood cells and neutro-

phils are subject to the patient's general condition and environment factors and may not necessarily reflect disease severity[12]. Clinicians should also consider other indicators, such as C-reactive protein and procalcitonin, in clinical diagnosis. This study showed that both pretreatment and posttreatment procalcitonin and C-reactive protein were significantly higher in the death group than in the recovery group (P<0.05), and C-reactive protein was significantly decreased after treatment in the recovery group (P<0.05). The serum level of C-reactive protein is low in normal individuals and can rise rapidly after infection[13]. Procalcitonin is highly stable and has important diagnostic value for early infections, as indicated by the significantly elevated serum procalcitonin after infection[14].

In addition, this study showed that the pretreatment erythrocyte sedimentation rate was significantly higher in the death group than in the recovery group. These data suggest that close monitoring of inflammatory markers, such as C-reactive protein, procalcitonin, and the erythrocyte sedimentation rate, can help assess patient conditions and guide clinical treatment. For patients with COVID-19, inflammatory mediators, hypoxia, and pathogens may cause a loss of vascular endothelial cells, resulting in coagulation disorders and disseminated intravascular coagulation, which can be life-threatening. In this study, the pretreatment D-dimer level was significantly higher in the death group than in the recovery group (P<0.05). Platelet counts were significantly higher after treatment in both the recovery group and the death group (P<0.05), although further research is needed to investigate the underlying mechanism. Analyses of liver and kidney function indicated that pretreatment and posttreatment aspartate aminotransferase and post-treatment creatinine were significantly higher in the death group than in the recovery group (P<0.05); furthermore, aspartate aminotransferase was significantly decreased after treatment in the recovery group (P<0.05). In the death group, liver and kidney dysfunction contributed to disease progression, suggesting that it is important to protect liver and kidney function in order to improve the recovery rate. Albumin directly represents nutritional status[15]. In this study, both pretreatment and posttreatment albumin levels were significantly lower in the death group than in the recovery group (P<0.05). Low serum albumin is usually associated with high disease incidence and mortality rates[16]. Major inflammation-related blood cells include neutrophils, lymphocytes, monocytes, and platelets; these indicators show significant individual variation and fluctuation, and any single indicator may be susceptible to susceptibility to many factors. Therefore, clinicians have been using composite indicators, such as LWR, NLR, PLR, and LMR, to assess the condition and prognosis of various diseases, including malignant tumor[17-19]. The composite indicators are more sensitive to the balance between inflammatory response and immune status. In this study, however, no significant correlation was found between these indicators and the outcome of SRAS-COV-2 infection, and further research is needed to confirm this conclusion. As the most important indicator of lung function, oxygen partial pressure was significantly lower in the death group than in the recovery group both before and after treatment (P<0.05). Patients with COVID-19 may develop hypoxia and subsequent difficulty breathing, which is a basis for diagnosis and an important indicator of severity.

In this study, all 126 endotracheal intubation patients received antiviral therapy at the hospital. No effective treatment is available for COVID-19, and ribavirin is currently the most common treatment for RNA viruses. In addition, in vitro studies have shown that to some extent, the anti-HIV drug lopinavir inhibited SRAS-COV-2 replication[20], and randomized controlled clinical studies are underway to investigate the efficacy and safety of lopinavir in patients with COVID-19 (ChiCTR2000029308). Remdesivir is the most promising antiviral drug for COVID-19. A recent case report published in New England Journal of Medicine reported that remdesivir was effective in a US COVID-19 patient[21], although clinical studies are needed to investigate the efficacy and safety of remdesivir for patients with SARS-CoV-2 infection. The Novel Coronavirus Pneumonia Diagnosis and Treatment Plan (Provisional 1st Edition) has clearly stated that interferon may be used to treat SARS-CoV-2 infection, as may the immune boosters γ-immunoglobulin and thymosin. However, this study showed no significant correlation between antiviral drugs, interferon therapy, human γ-immunoglobulin, or thymosin and disease outcomes (P>0.05), which may be related to the small sample size in this study. In this study, a significantly higher proportion of patients in the death group received antibiotic therapy (<0.05), and the glucocorticoids dosage was significantly higher in the death group than in the recovery group (P<0.05). Glucocorticoids are a double-edged sword and must be used properly to reduce mortality and prevent steroid-related adverse reactions.

The time from admission to intubation was significantly longer in the death group than in the recovery group (P<0.05),the proportion of use ECMO was significantly lower in the death group than in the recovery group (P<0.05). Therefore, timely monitoring and evaluation of patient conditions, early endotracheal intubation and use ECMO are crucial to improve the survival rate of intubated patients

This is a study with a small sample size that has potential bias. Moreover, the outbreak is not yet over, and it is important to identify risk factors for mortality and to develop standardized diagnosis and treatment protocols in order to improve the recovery rate of COVID-19 endotracheal intubation patients.

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