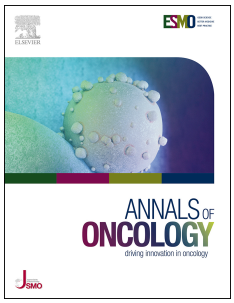

Clinical characteristics of COVID-19-infected cancer patients: A retrospective case study in three hospitals within Wuhan, China

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Clinical characteristics of COVID-19-infected cancer patients: A retrospective case study in three hospitals within Wuhan, China

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Abstract

Background： Cancer patients are regarded as a highly vulnerable group in the current Coronavirus Disease 2019 (COVID-19) pandemic. To date, the clinical characteristics of COVID-19-infected cancer patients are largely unknown.

Patients and methods： In this retrospective cohort study, we included cancer patients with laboratory confirmed COVID-19 from three designated hospitals in Wuhan, China. The clinical data were collected from medical records from Jan 13, 2020, to Feb 26, 2020. Univariate and multivariate analyses were performed to assess the risk factors associated with severe events defined as a condition requiring admission to an intensive care unit, the use of mechanical ventilation, or death.

Results: 28 COVID-19-infected cancer patients were included; 17 (60.7%) patients were male. Median age was 65.0 years (IQR:56.0-70.0). Lung cancer was the most frequent cancer type (7, 25.0%). 8 (28.6%) patients were suspected to be from hospital-associated transmission. The following clinical features were shown in our cohort: fever (23, 82.1%), dry cough (22, 81%) and dyspnoea (14, 50.0%), along with lymphopaenia (23, 82.1%), high level of high-sensitivity C-reactive protein (23, 82.1%), anaemia (21, 75.0%) and hypoproteinaemia (25, 89.3%). The common chest CT findings were ground-glass opacity (21, 75.0%) and patchy consolidation (13, 46.3%). 15 (53.6%) patients had severe events and mortality was 28.6%. If the last anti-tumour treatment was within 14 days, it significantly increased the risk of developing severe events (HR=4.079, 95%CI 1.086-15.322, P=0.037). Furthermore, patchy consolidation on CT on admission was associated with a higher risk for developing severe events (HR=5.438, 95%CI 1.498-19.748, P=0.010).

Conclusions: Cancer patients show deteriorating conditions and poor outcomes from the COVID-19 infection. It is recommended that cancer patients receiving anti-tumour treatments should have vigorous screening for COVID-19 infection and should avoid treatments causing immunosuppression or have their dosages decreased in case of COVID-19 co-infection.

Keywords: COVID-19; cancer; retrospective case study; severe clinical events

Highlight

- ✧ We retrospectively studied clinical features of 28 severe COVID-19-infected cancer patients from 3 hospitals in Wuhan, China.
- ✧ We analyzed risk factors associated with occurrence of admission to an ICU, usage of mechanical ventilation or death.
- ✧ COVID-19-infected cancer patients presented poor outcomes with high occurrence of clinical severe event and mortality.
- ✧ Anti-tumour treatment within 14 days of COVID-19 diagnosis increased the risk of developing severe events.

Introduction

In December 2019, a cluster of pneumonias of unknown pathogen was first announced in Wuhan, a city within the central part of China [1,2]. Earlier cases were linked to a large seafood and live animal market for selling different wild animal species[3]. The causative agent of the pneumonia was identified as a novel coronavirus and named severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2)[2]. Genetic analysis of the full-length genome sequences revealed SARS-CoV-2 to be most closely related to a known bat coronavirus termed BatCoV RaTG13, indicating bats as the likely origin[3]. This suggested the high possibility of animal-to-human transmission. Afterwards, human-to-human transmission was confirmed by a cluster of 15 health-care workers, who were all infected by one patient with the novel coronavirus infection[4]. Identification of the pathogen and transmission pattern have led to top-level preventive and control measures from the Chinese government and the World Health Organization (WHO), who consequently declared Coronavirus Disease 2019 (COVID-9) a public health emergency of international concern.

Prior to December 2019, 6 coronaviruses strains were known to infect humans, including two highly pathogenic strains, SARS-CoV and MERS-CoV, causing the severe acute respiratory syndrome (SARS) and four other strains causing respiratory illnesses ranging from a self-resolving cold to severe pneumonia[5]. SARS-CoV, which emerged in China in 2002, caused an epidemic with 8,098 infections and 774 deaths, with a case fatality rate of around 10%. Subsequently, MERS-CoV emerged in the Middle East, causing a persistent epidemic since 2012 and killing 34% of infected people between 2012 and 2019 (2,494 cases and 858 deaths). Like the other coronaviruses, SARS-CoV-2 primarily causes respiratory tract infections. An initial prospective study of the clinical features of 41 laboratory-confirmed cases in Wuhan demonstrated a severe illness that was clinically similar to SARS[6]. According to the China Centers for Disease Control and Prevention (CDC) report on 44,672 laboratory-confirmed cases nationwide between the initial outbreak and Feb 11, 2020, the overall case fatality rate of COVID-19 was 2.3%[7]. Although deaths from COVID-19 were less frequent compared to patients infected by SARSCoV

or MERS-CoV, COVID-19 was far more transmissible, with each new infected case producing an average of 2.68 new secondary cases[8]. By Feb 26, 2020, the ongoing outbreak had caused a total of 78,497 confirmed infected cases and 2,744 deaths in China, subsequently leading to a pandemic involving more than 70 countries[5].

In the COVID-19 crisis, cancer patients are regarded as a highly vulnerable group. A recent investigation of 18 patients who had been previously diagnosed with cancer, from a nationwide cohort of 2,007 COVID-19 cases, found that patients with cancer had a higher risk for severe clinical events than those without cancer[9]. The case fatality rate reached 5.6% among cancer patients compared with 2.3% in the general population[7]. However, with a relatively small sample size, limited clinical information, as well as high heterogeneity of the course of the disease, many critical issues concerning treatment principles for COVID-19-infected cancer patients still remain unclear. There is an urgent need to answer the following questions, including whether COVID-19-infected cancer patients will have distinct clinical courses and worse outcomes, such as death from the infection or severe pneumonia, and whether cancer patients should receive anti-tumour treatments as usual in epidemic areas. Therefore, we aimed to explore these issues by conducting an urgent retrospective case study on critical COVID-19-infected cancer patients.

Methods

Study design and participants

A retrospective case study was performed in three hospitals designated for COVID-19 patients in Wuhan; Tongji Sino-French New Town Hospital, Union Red Cross Hospital and Union West Hospital, all affiliated with the Tongji Medical College of Huazhong University of Science and Technology. Hospitalized cancer patients diagnosed with COVID-9 infection were identified between Jan 13, 2020 and Feb 26, 2020. Patients previously diagnosed with solid cancer and had a laboratory-confirmed SARS-CoV-2 infection were enrolled. Nasal and/or pharyngeal swabs were collected and tested for SARS-CoV-2 RNA with RT-PCR assay as previously described[6]. Clinical retrospective data was retrieved from the medical records, including demographic features, clinical features, laboratory findings and chest CT images. Two physicians (LZ and MZ) independently reviewed the data.

This study was approved by the Ethics Committee of the Tongji Medical College of Huazhong University of Science and Technology (No.TJ-IRB20200210). The requirement for informed patient consent was waived by the ethics committee due to the rapid emergence of this infectious disease.

Study Definitions

COVID-19 was diagnosed based on the criteria published by WHO and confirmed by RT-PCR of nasal and/or pharyngeal specimens. Acute Respiratory Distress Syndrome (ARDS) was defined according to the interim guidance of WHO for COVID-19[10]. Hospital-related transmission was suspected if a cluster of hospitalized patients in the same wards became infected in a certain time period and, under such cases, possible sources of infection were traced[11]. Severe clinical events (a composite endpoint) were defined as a condition admission to an Intensive Care Unit (ICU), the use of mechanical ventilation, or death[12].

Statistical analysis

For descriptive analysis, continuous variables were presented as the mean with Standard Deviation (SD) or as median with Interquartile Range (IQR), as appropriate. Categorical variables are presented as number (%). The Shapiro-Wilk test was used to test the normality of data distribution. The Kaplan-Meier method was used for time-to-event data to estimate the median time and its corresponding 95% confidence interval (CI). To explore potential factors of COVID-19-infected cancer patients developing severe clinical events, the Hazard Ratio (HR) and the corresponding 95% CIs from the Cox proportional hazards model were calculated. All statistical analysis was performed using SPSS Statistics version 26.0. A two-side P-value <0.05 was considered statistically significant.

Results

Demographic and Clinical Characteristics

The 28 patients with cancer were retrospectively enrolled from 1,276 patients (2.2%) who were admitted to three designated hospitals for quarantine and treatment of COVID-19 between Jan 13, 2020 and Feb 26, 2020. Demographic and clinical features are shown in Table 1. The median age

was 65.0 years (56.0-70.0); 17 (60.7%) of them were males. All patients were local residents of the three main districts of Wuhan and most of the patients (67.9%) were from Hankou, the starting point of the outbreak, where the Huanan market is located.

Among the cancer patients, lung cancer was the most frequent type of cancer (7, 25.0%), followed by esophageal cancer (4, 14.3%) and breast cancer (3, 10.7%). Ten patients (35.7%) were diagnosed with stage IV cancer. Baseline information on cancer history of all the cases are shown in Supplementary Table S1. All the patients had a history of anti-tumour therapy. Within 14 days of COVID-19 diagnosis, six (21.4%) patients had received at least one kind of anti-tumour therapy such as chemotherapy (3, 10.7%), targeted therapy (2,7.1%), radiotherapy (1,3.6%), immunotherapy (1, 3.6%); one of them received treatment combining chemotherapy and immunotherapy. There were two main clusters of patients: 8 (28.6%) patients who developed COVID-19 undergoing anti-tumour therapy in hospitals and 20 (71.4%) patients in their communities. In addition to cancer, 11 (39.2%) patients had at least one or more coexisting chronic diseases（Table 1). The most common symptoms on admission were fever (23, 82.1%), dry cough (22, 81%) and fatigue (18, 64.3%). 14 (50.0%) patients developed dyspnoea and 4 (14.3%) patients had a resting respiratory rate of more than 30 breaths per minute.

Laboratory and radiologic findings

Laboratory findings on admission are shown in Supplementary Table S2. The blood counts results showed anaemia in 21 (75%) patients, leucopaenia in 9 (32.1%) patients and lymphopaenia in 23 (82.1%) patients. Low levels of serum albumin (31.1, 28.6-34.8g/L) were observed in 25 (89.3%) patients and high levels of serum globulin (32.1, 27.9-37.1g/L) in 11 (39.3%) patients. High levels of lactate dehydrogenase (262.9, 168.5-508.0U/L) were found in 10 (50%) patients, highly sensitive C-reactive protein levels (hsCRP) in 23 (82.1%) patients and elevated erythrocyte sedimentation rate in 16 (57.1%) patients. Most patients (92.9%) had normal serum levels of procalcitonin. D-Dimer was elevated in 11(39.3%).

Radiologic features on chest CT on admission are also shown in Supplementary Table S2. All patients had abnormal findings on chest CT. 22 patients (78.6%) had bilateral involvement, while the rest (6, 21.4%) patients had unilateral focal involvement. Ground-glass opacity, the

predominant CT imaging pattern, was observed in 21 (75%) patients. Patchy consolidation was the second most common finding in 13 (46.3%) patients. Interstitial abnormalities, including reticular appearance, fibrous strips and interlobular septal thickening were found in 4 (14.3%) patients. Follow-up CT was performed 7-14 days after admission and showed improvement in 13 patients (46.4%), unchanged appearance in 5 patients (17.9%) and deterioration in 6 patients (21.4%). 4 patients (14.3%) did not obtain imaging data due to critical illness or death. Notably, in our study, CT images in 7 (17.9%) lung cancer patients showed reduced lung volume due to tumor volume, co-existing with features of pneumonia. Figure 1 demonstrates typical CT findings of two patients.

Treatment and complications

Treatment of patients are shown in Table 2. A total of 22 patients (78.6%) received oxygen therapy. 10 (35.7%) patients were put on invasive mechanical ventilation, with 2 (7.1%) requiring endotracheal intubation and invasive ventilation because of progressive hypoxia. Significantly more severe cases were subjected to mechanical ventilation (non-invasive: 53.3% vs 0%, P<0.001; invasive: 13.3% vs.0%, P<0.001) as compared to non-severe ICU cases. The median period of mechanical ventilation for non-invasive ventilation was 2.5 days (1.0-5.0 days) and for invasive was 2.5 days. None of the severe patients received extracorporeal membrane oxygenation（ECMO）in our study. In the COVID-19 outbreak, anti-virus agents are largely empirical, without evidence from randomized controlled trials. 20 (71.4%) patients were prescribed at least one antiviral agent, such as arborol (14, 50%), lopinavir/ritonavir (10, 35.7%), ganciclovir (9, 32.1%), and ribavirin (1, 3.6%), while 9 patients (32.1%) received combinations of antiviral agents. Empirical antibiotic were given to 23 patients (82.1%). Systemic corticosteroids were given to 15 patients (53.6%). Administration of corticosteroids was more frequent in patients with severe events (12/15, 80%) than non-severe cases (3/13, 23.1%). 7 of 8 ARDS patients received systemic corticosteroids. The dosage and period of corticosteroids in the severe cases was higher than non-severe cases (dose[mg/kg/d]:1.0 vs 0.6, period[d]: 3.0 (2.0-4.8) vs 5.0), but the difference was not significant. Moreover, intravenous immunoglobin was prescribed to 12 patients (35.7%).

The clinical outcome of patients is also shown in Table 2. As of Feb 26, 2020, fifteen (53.6%) of

the patients developed severe clinical events, 6 (21.4%) patients were admitted to ICU, 10 (35.7%) patients had life-threatening complications and 8 (28.6%) of the patients died. Of the ten stage IV cancer patients, 7(70%) had developed severe events, while 44.4% of the non-stage IV patients had such events. Among 6 cancer patients who received anti-tumor treatment within 14 days of diagnosed COVID-19, 5 (83/%) developed severe events. Additionally, 84.6% patients (11/13) with patchy consolidation on CT on admission had developed severe events.

The most common complication was ARDS (8, 28.6%), followed by septic shock (1, 3.6%), and acute myocardial infarction (AMI) (1, 3.6%). Two patients (7.1%) were suspected to have pulmonary embolism. 10 (35.7%) of 28 patients had been discharged with a median hospital stay 13.5 days (IQR 10.8-17.8); 10 (35.7%) cases were still inpatients with a median stay of 19.0 days (IQR 16.0-28.5). Of the 28 patients, 8 (28.6%) died, with a median time 16.0 days (IQR 9.0–22.3) from admission to death. The cause of death included ARDS (5/8,62.5%), followed by pulmonary embolism (1/8, 12.5%), septic shock (1/8, 12.5%) and AMI (1/8, 12.5%).

Risk factors for developing severe event

The association of clinical factors with severe events is summarized in Supplementary Table S3 by, univariate Cox proportional hazards model. Compared with those who did not receive anti-tumour treatment within 14 days, cancer patients who received anti-tumour treatment within 14 days before COVID-19 diagnosis, including chemotherapy (3, 10.7%), radiotherapy (1, 3.6%), targeted therapy (2, 7.1%) and immunotherapy (1, 3.6%, combined with chemotherapy), had a higher risk of developing severe events with borderline statistical significance. Moreover, patchy consolidation on the first CT on admission suggested an elevated risk of developing severe events than those cases without consolidation (HR=5.000, 95%CI 1.576-15.861, P=0.006).

Similar results were observed in the multivariate-adjusted Cox proportional hazards model after being adjusted for age and gender (Table 3). Cancer patients who had received last anti-tumour treatment within 14 days had a statistically significant increased risk of developing severe events (HR = 4.079, 95%CI 1.086-15.322, P=0.037). Furthermore, cancer patients with patchy consolidation on CT on admission had a higher risk for developing severe events (HR=5.438, 95%CI 1.498-19.748, P=0.010). The adjusted survival curve of severe events showed that cancer

patients who underwent anti-tumour treatment in the past 14 days or patchy consolidation in CT on admission had significantly higher severe events (Figure 2a and 2b).

Discussion

The clinical characteristics of 28 cancer patients with laboratory confirmed COVID-19 from three designated hospitals in Wuhan, China, as at Feb 26, 2020 are described. 53.6% of the patients developed severe events, 21.4% were admitted to ICU, 35.7% had life-threatening complications and 28.6% of the patients died.

Our results showed the following clinical features of COVID-19-infected cancer patients: typical symptoms of fever, dry cough, fatigue and dyspnoea, along with blood lymphopaenia and high levels of hsCRP. Cancer patients present with similar clinical features to general population, except for anaemia and hypoproteinaemia, which were frequently found in this cohort. Anaemia and hypoproteinaemia were considered to be a major consequence of nutritional deterioration in cancer patients, which may adversely affect immunocompetence and increase the susceptibility to respiratory pathogens. In our cohort, the symptom of dyspnoea was found to occur much earlier from the onset of COVID-19 infection in lung cancer patients as compared to the general population (1.0 [0.0-3.5] vs 8.0 [5.0-13.0] days)[11], and earlier as compared to other cancer patients (1.0[0.0-3.5] vs 5.0[4.0-7.0] days). Patients with lung cancer, with worse baseline lung function and endurance, are more likely to develop more severe anoxia and progress more rapidly with COVID-19. This leads to urgency and increased attention in the COVID-19-infected cancer patients, with special emphasis on patients with lung cancer.

Under this study, the severe events were defined as the admission to ICU, or mechanical ventilation, or death. In this population, 53.6% of the cancer patients developed severe events, with 28.6% of the patients dying. In the general COVID-19-infected population, 4.7% confirmed cases reached clinically critical status, and nearly half of the critical cases (2.3%) were fatal[7]. Patients with cancer are particularly susceptible to respiratory pathogens and severe pneumonia, because they are at an immunosuppressive state due to malignancy and anti-tumour therapy. It was found that within 14 days, anti-tumour therapies were significantly associated with occurrence of severe clinical events in COVID-19 infection. Previous investigations by Liang et al [9] showed a

lower percentage of cancer patients (7 [39%] of 18 patients) developing severe events. The main reasons for the discrepancy can be attributed to variation in the definition of severe events and the study populations. Liang et al [9] defined clinical severe events as the patients' admission to the ICU requiring invasive ventilation, or death. Their cohort narrowed the scope of severe cases to patients under invasive ventilation, which is different from all the mechanical ventilation cases enrolled in our study. All the cases in our cohort came from Wuhan, whereas the cases of Liang et al were from the entire nation. Wuhan faced a dire shortage of medical resources to cope with the influx of patients at early stage of the outbreak, and some patients were not admitted to the hospital in time; hence, it is presumed that delayed admission contributed in increased mortality.

We also found that the CT feature of patchy consolidation on admission is a risk factor associated with severe events. Ground-glass opacity and patchy consolidation were both common CT findings in COVID-19-infected cancer patients, similar to the features in the general population[13]. Shi H et al[13] analyzed the timing of emergence and persistence of those features on CT. They found that ground-glass opacity appeared first, even before symptom onset, then increased during the following two weeks, and decreasing gradually in the third week. Patchy consolidation usually appeared in first to second weeks after symptom onset. It can rapidly evolve into bilateral extensive consolidation, with a white lung appearance on CT, leading to poor prognosis. Therefore, CT on admission showing patchy consolidation may imply that admission time of these cases would be at least 1 to 2 weeks after the onset of illness. The delayed admission time for cancer patients may be a reasonable explanation for the poor outcome of some cases in our cohort.

In our cohort, 71.4% of the patients were prescribed at least one antiviral agent. About one-third of patients received more than one antiviral agent. However, currently there is no drug that has proven to be effective against SARS-CoV-2. Systemic steroids remain controversial in the treatment of viral pneumonia. Usage of steroids has been considered to slow virus clearance due to its immunosuppressive effect, which was often associated with an increased risk of opportunistic infections, especially in patients who required mechanical ventilation. In our observations, even though more than half of patients received steroids treatment, we couldn't demonstrate reduced incidence of severe events in our cancer patient cohort.

It was also noted that 28.6% of our patients had developed COVID-19 infection during hospitalization and nosocomial transmission of SARS-CoV-2 was suspected. Hospital-related transmission has been reported in both patients and healthcare workers. In a retrospective case study with 138 patients, 41.3% of the patients were reported to have acquired COVID-19 infection during hospitalization, and out these, 5 patients were from the oncology department[11]. Nationwide statistics of the China CDC confirmed COVID-19 transmission within patients in healthcare settings[7]. Human-to-human transmission has also been previously confirmed in familial clusters or travel-related clusters [14,15]. Transmission of SARS-CoV and MERS-CoV had also been confirmed to occur through nosocomial transmission. Therefore, healthcare facilities need to re-emphasize the importance of basic infection control measures to combat the spread of contagious pathogen via respiratory droplets.

Some cancer patients are also shown to have acquired COVID-19 infection on receiving anti-tumour treatment during hospitalization. However, delaying anti-tumour treatment cannot be recommended as a reasonable choice to reduce the infection risk in the ongoing pandemic. Cancer patients should receive anti-tumour treatment in the setting of vigorous screening for COVID-19, including chest CT scan and nucleic acid testing, and the same should be extended to their companions. Treatment strategies likely to cause immunosuppression should be avoided or have dosages decreased, and patients who are generally in poor condition should not receive such treatments. In addition, at least 7 days prior to anti-tumour treatment, cancer patients should stay in the observation ward and in isolation from other patients. Stronger personal protection, including protection mechanisms for their families should be made for cancer patients.

Our findings support the vulnerability of cancer patients in current pandemic. However, our findings are also based on some study limitations. First, the study was retrospective, nonrandomized and was based on a small sample size. The tumor types were diverse, and heterogeneity could not be avoided. Second, some important confounders were not able to be included in the multivariate analyses, such as tumor stage. In the descriptive analyses, we found that 70% of stage IV patients developed severe events. Although the univariable analyses showed no statistically significant associations, we still suggest that the stage of cancer may affect the

clinical course of COVID-19-infected cancer patients. However, we could not include tumour stage in the multivariable cox model analysis due to the high correlation between stage and anti-tumour treatment within 14 days (correlation coefficient r=-0.518, P=0.005). Third, due to an urgent and retrospective descriptive study design, we only report crude rates of complications and fatality in cancer patients with COVID-19 infection. The comparisons between cancer and non-cancer patients with COVID-19 infection could reveal more useful information, as would comparisons of less severe cases not included in our study population. Thus, future studies with larger sample sizes and prospective study designs are warranted to further explore the risk factors and severe events in COVID-19-infected cancer patients.

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Disclosure

All authors have declared no conflicts of interest.

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Figure legends

Figure 1. Representative images of the Chest CT at different times throughout the disease course.

Axial CT scanning (A-C) and coronal scanning (D-F) images are from a 70-year-old woman, who diagnosed with adenocarcinoma and recieved left upper lobectomy in 2010. As adenocarcinoma recurred in 2012, she has so far received 4 courses of chemotherapy and targeted therapy (gefitinib) ; (A, D) Day 1 after symptom onset: left lung with reduced lung volume after left upper lobectomy, multifocal ground-glass opacities in the bilateral inferior lung lobes (arrows); (B, E) Day 10 after symptom onset: progressive diffused ground-glass opacities and consolidation (arrows) in bilateral subpleural regions; (C, F) Day 25 after symptom onset: improvement of ground-glass opacities and little fibrous stripe in right lower lung (arrow).

Coronal CT scanning (G-I) images are from a 47-year-old man, who was diagnosed with nasopharyngeal carcinoma in 2016. Radiotherapy adjuvant chemotherapy were performed; (G) Day 21 after symptom onset: diffused ground-glass opacities, obvious consolidation, mixed and reticular in bilateral lungs; (H) Day 28 after symptom onset: decreased GGO, consolidation and interlobular septal thickening (arrow); (I) Day 32 after symptom onset: further improvement appearance with predominant reticular patterns (arrows).

Figure 2. Kaplan-Meier curve of risk factors for developing severe events, adjusted by age and gender. (A) Cancer patients who received anti-tumor treatment within 14 days before COVID-19 diagnosis or more than 14 days. (B) Patchy consolidation in the first CT scan on admission or no on admission.

Table 1. Demographic and base line clinical characteristics of COVID-19 infected cancer patients

Characteristic	Patients (n=28), No. (%)
Median age (IQR)，Year	65.0 (56.0-70.0)
Male sex	17 (60.7)
Residential district	
Wuchang	6 (21.4)
Hankou	19 (67.9)
Hanyang	3 (10.7)
Patients' hospital	
Tongji Sino-French New Town Hospital	14 (50)
Union West Hospital	2 (7.1)
Union Red Cross Hospital	12 (42.9)
Tumor diagnosis	
Lung cancer	7 (25.0)
Esophagus cancer	4 (14.3)
Breast cancer	3 (10.7)
laryngocarcinoma	2 (7.1)
Liver cancer	2 (7.1)
Prostatic cancer	2 (7.1)
Cervical cancer	1 (3.6)
Gastric cancer	1 (3.6)
Colon cancer	1 (3.6)
Rectum cancer	1 (3.6)
Nasopharynx cancer	1 (3.6)
Endometrial cancer	1 (3.6)
Ovarian cancer	1 (3.6)
Carcinoma of testis	1 (3.6)

Tumor stage	
Stage I/II/III	18 (64.3)
Stage IV	10 (35.7)
History of prior treatment	
Operation[a]	21 (75.0)
Chemo/radiotherapy [a]	25 (89.3)
Target/immunotherapy [a]	6 (21.4)
Chemotherapy (<14days) [b]	3 (10.7)
Radiotherapy (<14days) [b]	1 (3.6)
Target therapy (<14days) [b]	2 (7.1)
Immunotherapy(<14days) [b,c]	1 (3.6)
Source of infection	
In Community	20 (71.4)
Nosocomial transmission	8 (28.6)
Co-morbidities	
Diabetes	4 (14.3)
Chronic Cardiovascular and cerebrovascular disease (including hypertension and CHD)	4 (14.3)
Chronic pulmonary disease (including COPD and asthma)	1 (3.6)
Chronic liver disease (including chronic hepatitis B and cirrhosis)	2 (7.1)
Symptoms and signs at on admission	
Fever	23 (82.1)
Cough	22 (78.6)
Fatigue	18 (64.3)
Dyspnoea	14 (50)
Myalgia	4 (14.3)

Diarrhea	3 (10.7)
Chest pain	2 (7.1)
Fever time, Days	7 (0-30)
Fever to dyspnoea time，Days	
Lung cancer	1.0 (0.0-3.5)
Non lung cancer	5.0 (4.0-7.0)

Abbreviations: CHD, coronary heart disease; COPD, chronic obstructive pulmonary disease.

[a] Treatment after the diagnosis of cancer

[b] Time from last anti-tumor treatment to diagnosis of COVID-19

[C] One patient received treatment combined chemotherapy and immunotherapy

Table 2. Treatment and clinical outcome of COVID-19 infected cancer patients

Treatment	No. (%), median (IQR)
Physiotherapy	
Oxygen therapy	22 (78.6)
Mechanical ventilation	10 (35.7)
Non-invasive/severe, days	8/15 (53.3), 2.5(1.0-5.0)
Invasive/severe	2 /15 (13.3), 2.5(NA)
ECMO	0
Admission to ICU	6 (21.4)
Medicine therapy	
Antibiotic treatment	23 (82.1)
Antiviral treatment (dose/day)	20 (71.4)
lopinavir/ritonavir (400/100mg, o.p. bid)	10 (35.7)
Arbidol (200mg, o.p. tid)	14 (50.0)
Ganciclovir (500mg, iv drip bid)	9 (32.1)
Ribavirin (500mg, iv drip bid)	1 (3.6)
Combination (＞1 drug)	9 (32.1)
Systemic corticosteroids	15 (53.6)
Intravenous immunoglobin, days	10.0 (35.7), 3.0(1.0-3.0)
Time from symptoms to hospitalization, days	6.0 (3.0-10.0)
Complications	
ARDS	8 (28.6)
Septic shock	1 (3.6）
Pulmonary embolism suspected[a]	2 (7.1)
AMI[a]	1 (3.6)
Severe events	15 (53.6)
Time from diagnosis to severe events	7.0 (5.0-15.0)
Occurrence of severe events	

Stage IV vs Non-stage IV	7/10 (70.0) vs 8/18 (44.4)
Anti-tumor <=14 vs >14 days [b]	5/6 (83.3) vs10/22 (45.5)
Anti-tumor <=30 vs >30 days [c]	5/12 (41.7) vs10/16 (62.5)
Patchy Consolidation vs no patchyconsolidation [b]	11/13 (84.6) vs 4/15 (26.7)*
CT scan evaluation	
Improvement	13 (46.4)
Unchanged appearance	5 (17.9)
Deterioration	6 (21.4)
NA	4 (14.3)
Clinical symptoms evaluation	
Improvement	14 (50.0)
Stable	3 (10.7)
Worse	11 (39.3)
Clinical outcomes	
Staying in hospital	10 (35.7)
Discharge from hospital	10 (35.7)
Death	8 (28.6)
Hospital stay (Pts. staying in hospital), days	19.0 (16.0-28.5)
Hospital stay (Pts. discharge), days	13.5 (10.8-17.8)
Time from diagnosis of infection to death, days	16.0 (9.0-22.3)
Cause of death	
ARDS	5 (62.5)
Septic shock	1 (12.5)
Pulmonary embolism suspected	1 (12.5)
AMI	1 (12.5)

Abbreviations: ARDS, acute respiratory distress syndrome; ECMO, extracorporeal membrane oxygenation; AMI, acute myocardial infarction; Pts, patients;

[a] One patient coincidence ARDS

[b] Time from last anti-tumor treatment to diagnosis of COVID-19

[c] CT scan on admission

*p＜0.05

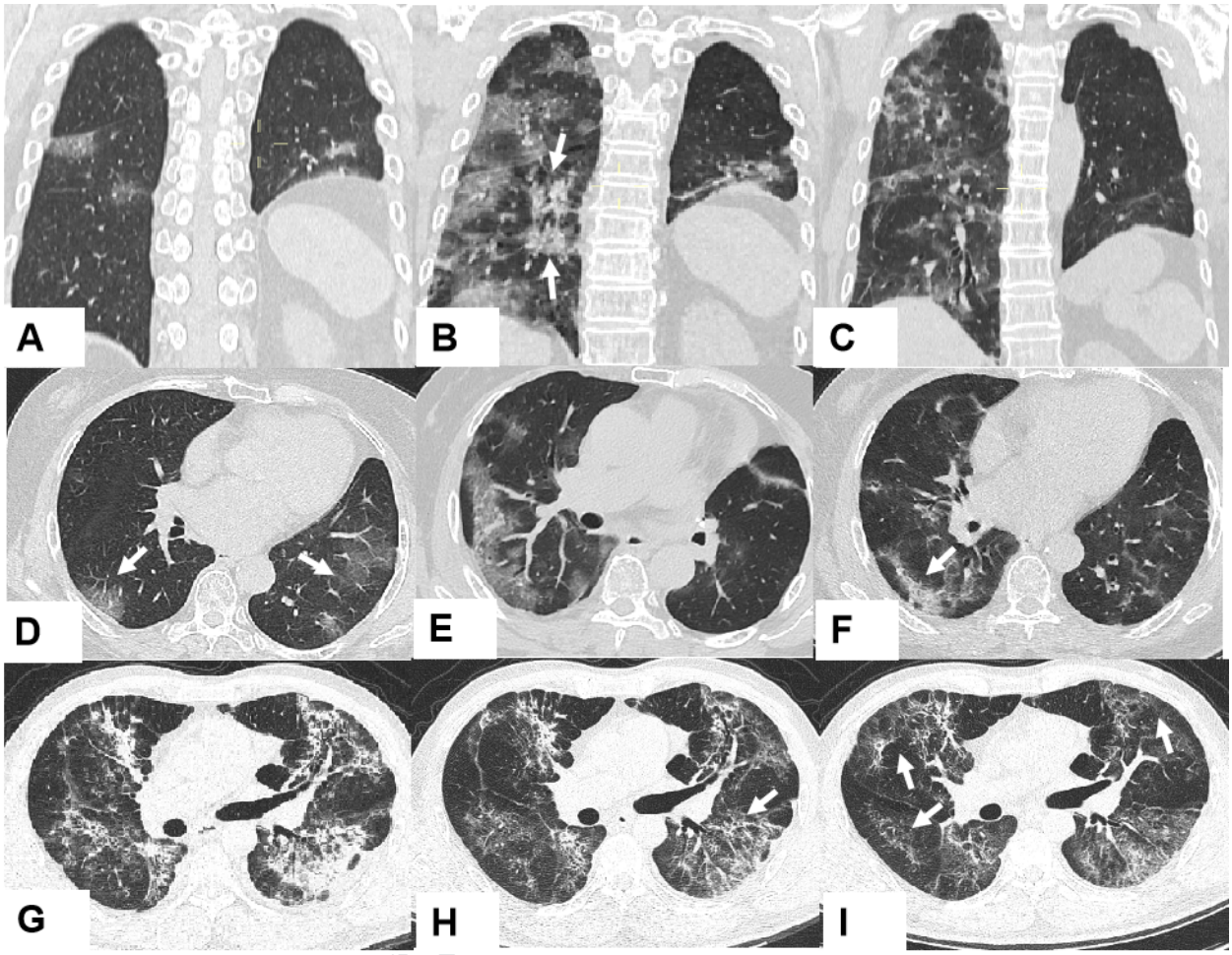
Table 3. Multivariate analysis for the risk of severe events

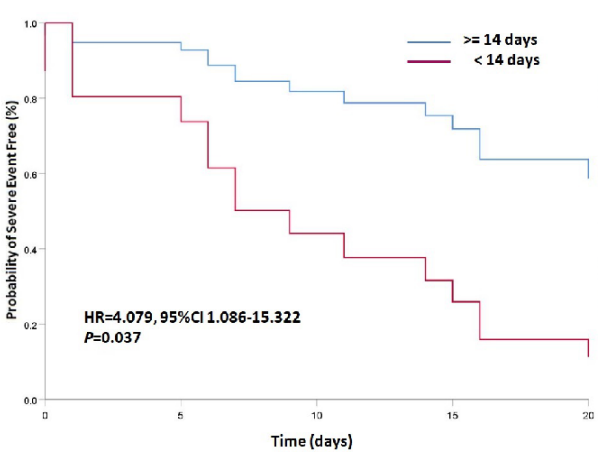
Clinical Factors	HR	95% CI	P
Gender	0.574	0.162-2.038	0.390
Age	1.455	0.478-4.430	0.509
Anti-tumor <=14 days[a]	4.079	1.086-15.322	0.037
Patchy consolidation[b]	5.438	1.498-19.748	0.010

Abbreviations: A two-side P-value <0.05 was considered statistically significant. HR, hazard ratio; CI, confidence interval.

[a] Time from last anti-tumor treatment to diagnosis of COVID-19

[b] CT scan on admission





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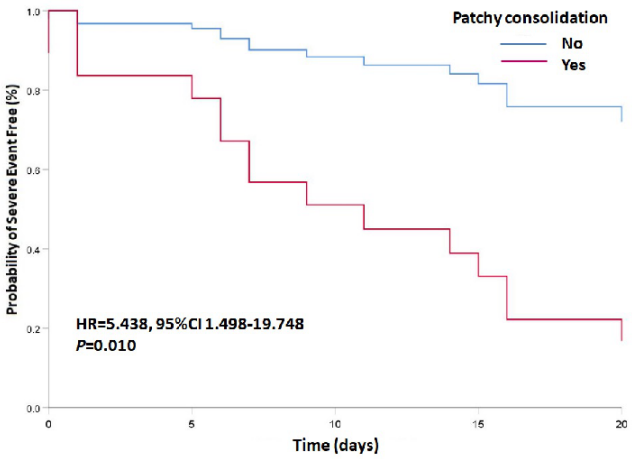

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