Co-infection of SARS-COV-2 and influenza A virus: a case series and fast review

Xuan Xiang

Department of Respiratory and Critical Care Medicine, Union Hospital, Tongji Medical College, Huazhong University of Science and Technology, Wuhan 430022, China

Zi-Hao Wang

Department of Respiratory and Critical Care Medicine, Union Hospital, Tongji Medical College, Huazhong University of Science and Technology, Wuhan 430022, China

Xin-Liang He

Department of Respiratory and Critical Care Medicine, Union Hospital, Tongji Medical College, Huazhong University of Science and Technology, Wuhan 430022, China

Xiao-Shan Wei

Department of Respiratory and Critical Care Medicine, Union Hospital, Tongji Medical College, Huazhong University of Science and Technology, Wuhan 430022, China

Yan-Ling Ma

Department of Respiratory and Critical Care Medicine, Union Hospital, Tongji Medical College, Huazhong University of Science and Technology, Wuhan 430022, China

Hui Li

Department of Respiratory and Critical Care Medicine, Union Hospital, Tongji Medical College, Huazhong University of Science and Technology, Wuhan 430022, China

Long Chen

Department of Respiratory and Critical Care Medicine, Union Hospital, Tongji Medical College, Huazhong University of Science and Technology, Wuhan 430022, China

Xiao-Rong Wang

Department of Respiratory and Critical Care Medicine, Union Hospital, Tongji Medical College, Huazhong University of Science and Technology, Wuhan 430022, China

Qiong Zhou (✉ zhouqiong@tj126.com)

Department of Respiratory and Critical Care Medicine, Union Hospital, Tongji Medical College, Huazhong University of Science and Technology, Wuhan 430022, China

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Abstract

Background: COVID-19 has become a global pandemic. Studies about SARS-CoV-2 co-infection with influenza A virus (IAV) in the influenza season will contribute to the antiviral interventions of co-infected patients.

Methods: A cohort of 145 COVID-19 patients in Wuhan union hospital were reviewed and we found 2 patients were co-infected with both SARS-CoV-2 and IAV. Then we searched from PubMed, Web of Science and CNKI with combinations of the following key words: "COVID-19, SARS-COV-2, influenza A and co-infection" from January 1 up to May 1, and 6 studies were included in this descriptive analysis.

Results: Of the 13 co-infected patients, 2 were from Wuhan union hospital, another 11 were collected from the reports published on PubMed, Web of Science and CNKI. Of the 13 patients, the median age was 50 years (IQR, 40.5-67.5). Among the 13 patients, 7 (53.8%) were severe types. The most common symptoms among the 13 patients were cough (100%), fever (92.3%) and dyspnea (76.9%). 8 patients had lymphocytopenia on admission and all the 13 patients had abnormal radiological changes. The median time from symptom onset to hospital admission was 4.5 days (IQR, 2.75-5.5), and the median time of hospital stay was 17 days (IQR,15-20).

Conclusion: Patients with both SARS-COV-2 and IAV infection showed similar changes in symptoms and radiological images with patients infected with SARS-COV-2 only. SARS-COV-2 co-infection with IAV can lead to more severe clinical condition but had similar hospital stay compared with patients infected with SARS-COV-2 only in the fast review.

Introduction

A new acute respiratory disease reported in last winter named coronavirus disease 2019 (COVID-19), was found to be caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). It was revealed that SARS-COV-2 virus felled within the subgenus *Sarbecovirus* of the genus *Betacoronavirus*, with about 79% identity to SARS-COV and sharing a similar receptor-binding domain structure to that of SARS-COV, despite a little difference in some residues¹. This virus now has swept the world with a stunning speed and brought tremendous pressure to the medical system. Many studies had described the clinical characteristics and radiological changes of COVID-19. The most common symptoms of COVID-19 were fever and cough^{2,3}, and the most representative images of computed tomography were peripheral ground-glass opacities^{4,5}.

Influenza A viruses (IAV) belong to the *Orthomyxoviridae* family and are further divided into subtypes according to the two surface glycoproteins, haemagglutinin and neuraminidase. IAV can cause acute respiratory illnesses which usually occur in winter seasons periodically and often cause severe illnesses and economic loss around the world^{6,7}. Based on the features of host and virus, patients infected with IAV could present different symptoms, including fever, chills, myalgia and respiratory symptoms such as dry cough, nasal tampon, etc. The typical changes in chest radiology images of IAV patients were ground-glass opacities and consolidation^{8,9}.

In clinic, co-infection can happen in viral-bacterial and viral-viral infection during the influenza season and cause more severe clinical conditions^{10, 11}. We also find some patients were infected with both SARS-COV-2 and IAV in the COVID-19 pandemic¹²⁻¹⁴. Due to the scattered cases, we do not have a profile knowledge about the course of those co-infected patients. It deserves more attention to those patients who suffers from co-infection with SARS-CoV-2 and IAV. Herein we reviewed some published studies and described a cohort of patients co-infected with SARS-CoV-2 and IAV in the COVID-19 pandemic, aiming to explore more knowledge about COVID-19.

Materials And Methods

We retrospectively screened out two patients infected with both SARS-COV-2 and IAV in 145 confirmed COVID-19 patients in Wuhan Union Hospital and oral consents were obtained from the two patients. Then we searched PubMed (National Library of Medicine, Washington, DC), Web of Science and CNKI (China National Knowledge Infrastructure) from January 1 up to May 1, 2020, using a combination of the following key words: COVID-19, SARS-COV-2, influenza A and co-infection. We also reviewed the reference lists of retrieved articles to search for other proper studies. Studies were selected if they met the following criteria: clinical studies and case report on SARS-COV-2 and IAV co-infection.

Data extraction

For each study, the following information was extracted: the author's last name; year; country; number of patients got co-infected with SARS-COV-2 and IAV; study design; selected clinical data (age; gender; comorbidities; date of symptom onset; date of admission to hospital; days in hospital; symptom before admission; lymphocyte count on admission; oxygen saturation on admission; the first radiological images after admission; treatment; clinical events: acute liver injury, acute respiratory distress syndrome, noninvasive ventilation, endotracheal intubation, intensive care unit (ICU); clinical ending: death or discharged). Patients were divided into moderate type (fever, cough and other symptoms are presented with pneumonia on chest CT scans) and severe type (severe type was defined if one of the following conditions was met: a. respiratory distress, respiratory rate ≥ 30 per min; b. oxygen saturation on room air at rest $\leq 93\%$; c. partial pressure of oxygen in arterial blood / fraction of inspired oxygen ≤ 300 mmHg) according to the Diagnosis and Treatment of Protocol of COVID-19¹⁵.

Data analysis

Frequency with percentages (%) was used to describe categorical variables. Continuous variables were described using median and interquartile range (IQR) values. All statistical analyses were performed with GraphPad Prism 8.0.2.

Results

We collected 12 articles on SARS -COV -2 and IAV co-infection from PubMed, Web of Science and CNKI and excluded 6 studies for those that did not include clinical information of patients. The remaining 6 articles (1 was clinical study and the other 5 were case reports) provided us 11 cases with clinical information. Thus our

cohort had 13 patients who suffered from both SARS -COV -2 and IAV co-infection in the pandemic.^{12-14, 16-18} (Table 1).

In this descriptive study, 7 patients (53.8%) were severe cases, 7 (53.8%) were males, the median age was 50 years (IQR, 40.5-67.5). 5 patients (38.5%) had comorbidities such as hypertension, diabetes, kidney tumor, cerebrovascular disease, coronary artery disease, dyslipidemia, hypothyroidism, pituitary microadenoma, congestive heart failure, chronic kidney disease. The most common symptoms before admission were cough (100%), fever (92.3%), dyspnea (76.9%) and myalgia (53.8%). Other symptoms such as fatigue, anorexia, headache, nasal tampon, expectoration, pharyngalgia, diarrhea, chest pain and chill were also seen in the cohort (Table 2).

On admission, 8 patients (61.5%) had decreased lymphocyte count, 6 of 10 patients (60%) had lower oxygen saturation ($SpO_2 \leq 93\%$) on ambient air. All the 13 patients (100%) had abnormal radiological changes in their first examination after admission. The median time from symptom onset to hospital admission was 4.5 days (IQR, 2.75-5.5), and the median time of hospital stay was 17 days (IQR, 15-20). Among the patients, 6 of 9 (66.7%) had oxygen inhalation, including 1 received noninvasive ventilation, and 2 patients received endotracheal intubation in the ICU. 8 of 9 patients (88.9%) had oseltamivir treatment, and 7 of 8 patients (87.5%) had other antiviral treatment except oseltamivir. 8 patients (100%) received antibiotic therapy, only 3 of 8 (37.5%) were treated with corticosteroids. 2 patients suffered from acute liver injury and 2 developed into acute respiratory distress syndrome during the clinical course. 7 patients were discharged. The remaining 6 patients' clinical outcome were not available. (Table 3).

Discussion

Viruses co-infection were usually seen in the influenza epidemic and pandemic^{19, 20}. Goka et al found that IAV and influenza B virus co-infection associated with a significant increase in risk of admission to ICU or death, whereas co-infection with IAV and other viruses significantly increased the risk of admission to a general ward¹⁹. In the COVID-19 pandemic, we found some patients were co-infected with SARS-COV-2 and IAV but we did not know much more about the two viruses' co-infection. To better understand the clinical course of SARS-COV-2 and IAV co-infection, we performed a fast review on patients both infected with the two viruses.

In this review, we collected 13 patients co-infected with SARS-COV-2 and IAV in China, Japan, Iran and America^{12-14, 16-18}. In the 13 patients, the proportion of severe type was 53.8% (7 cases), which was much higher than that in COVID-19²¹, indicating co-infection with SARS-COV-2 and IAV resulting in more severe condition. IAV infection was more common in children and old people⁶, while we only found one child suffering from SARS-COV-2 and IAV co-infection in our cohort¹⁷. Similar to the COVID-19 patients, the patients co-infected with SARS-COV-2 and IAV also manifested symptoms such as fever, cough, dyspnea and myalgia etc. However, in this review, we found 10 of 13 patients (76.9%) had dyspnea on admission, higher than that reported by Wang and Huang et al (31.2% and 55% respectively)^{2, 3}. This may remind us that COVID-19 patients co-infected with IAV may develop a more severe disease in lower respiratory tract. The median time of hospital stay in this review was 17 days (IQR, 15-20), similar to the finding (median, 18 days,

IQR, 14-27) reported by Xu et al²². The reason why patients co-infected with SARS-COV-2 and IAV developed more severe clinical condition while had similar hospital stay need further research. All the patients had typical abnormal radiological changes and 7 of 13 patients (53.8%) had lower lymphocyte count on admission, which could indicate viral infection but could not tell the pathogens relying on these signs.

In this review, we found 8 of 9 patients (88.9%) were treated with oseltamivir, a neuraminidase inhibitor recommended to deal with influenza by the European Union and the USA^{23, 24}, and 8 of 8 patients received antibiotic therapy to prevent secondary bacterial infection²⁵. But whether oseltamivir has some effect on SARS-COV-2 viral shedding and whether co-infection with SARS-COV-2 and IAV may cause secondary infection need further investigation. Three patients were treated with corticosteroids, while corticosteroids were not usually recommended in the COVID-19 pandemic concerning about the possible side effects of corticosteroids on virus clearance and association with high rates of complications^{26, 27}. 7 patients were cured and discharged from hospital while 6 patients did not have detailed information on clinical course.

We noticed the patients co-infected with SARS-COV-2 and IAV accounted for a small proportion in the COVID-19 pandemic^{28, 29}. This may due to the interference between viruses³⁰, and SARS-COV-2 took the dominated place in the pandemic. The mechanism of how SARS-COV-2 and IAV interfere each other deserves further study.

Our study has some limitations: first and most, though this was a fast review, our samples were extremely small due to the rare reports on SARS-COV-2 and IAV co-infection. Second, we could not collect detail information about each patient because some information was not available, and whether the missing information may have some influence on our results was unknown. Third, the reports did not provide SARS-COV-2 viral shedding time, thus whether co-infection with IAV have some influence on SARS-COV-2 viral shedding remains unknown. Fourth, we could not identify which virus was first infected, which may contribute to account for the co-infection course. Finally, no patient got lower respiratory tract samples for detection for SARS-CoV-2 and IAV in this review, so whether the two viruses were both involved in the pathological progression of pulmonary could not be identified. However, this review highlights that we should pay attention to the problem of co-infection of two or more respiratory pathogens. The association between the occurrence of co-infection and substantially higher severity of disease deserves further study, but a rapid and proper diagnostic of wide spectrum of viral respiratory pathogens reveals an accurate picture of the disease and is essential for appropriate therapeutic management and control of infection.

Declarations

Author contribution statement:

Qiong Zhou conceived the idea, designed and supervised the study, had full access to all data and took responsibility for the integrity of the data. Xuan Xiang and Zi-Hao Wang participated in the design, implementation and drafting of the article; Hui Li, Yanling Ma and Xiaoshan Wei participated in the collection and collation of clinical data; Xinliang He, Long Chen and Xiaorong Wang participated in the analysis and discussion of clinical data. All the authors agreed to the submission to Current Medical Science.

Ethical statement

Data collection and analysis of cases were determined by the National Health Commission of the People's Republic of China to be part of a continuing public health outbreak investigation and were thus considered exempt from institutional review board approval.

Declaration of interests:

All authors declare no competing interests.

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Data statement

The data information was available in Supplementary 1 at Current Medical Science's website.

References

1. Lu R, Zhao X, Li J, et al. Genomic characterisation and epidemiology of 2019 novel coronavirus: implications for virus origins and receptor binding. *The Lancet*. 2020; **395**(10224): 565-574.
2. Wang D, Hu B, Hu C, et al. Clinical Characteristics of 138 Hospitalized Patients With 2019 Novel Coronavirus–Infected Pneumonia in Wuhan, China. *JAMA*. 2020; **323**(11): 1061.
3. Huang C, Wang Y, Li X, et al. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. *The Lancet*. 2020; **395**(10223): 497-506.
4. Chung M, Bernheim A, Mei X, et al. CT Imaging Features of 2019 Novel Coronavirus (2019-nCoV). *RADIOLOGY*. 2020: 200230.
5. Zhang R, Ouyang H, Fu L, et al. CT features of SARS-CoV-2 pneumonia according to clinical presentation: a retrospective analysis of 120 consecutive patients from Wuhan city. *EUR RADIOL*. 2020.
6. Thompson WW. Influenza-Associated Hospitalizations in the United States. *JAMA*. 2004; **292**(11): 1333.
7. Lafond KE, Nair H, Rasooly MH, et al. Global Role and Burden of Influenza in Pediatric Respiratory Hospitalizations, 1982–2012: A Systematic Analysis. *PLOS MED*. 2016; **13**(3): e1001977.
8. Collins JP, Campbell AP, Openo K, et al. Clinical Features and Outcomes of Immunocompromised Children Hospitalized With Laboratory-Confirmed Influenza in the United States, 2011-2015. *J PEDIAT INF DIS SOC*. 2019; **8**(6): 539-549.
9. Sargın G, Şentürk T, Ceylan E, et al. Clinical, radiological and prognostic features of influenza cases in the influenza epidemic during years 2016-2017. *Tuberkuloz ve Toraks*. 2018; **66**(2): 136-143.
10. McCullers JA. Insights into the Interaction between Influenza Virus and Pneumococcus. *CLIN MICROBIOL REV*. 2006; **19**(3): 571-582.

11. Martin-Loeches I, J Schultz M, Vincent J, et al. Increased incidence of co-infection in critically ill patients with influenza. *INTENS CARE MED*. 2017; **43**(1): 48-58.
12. Khodamoradi Z, Moghadami M, Lotfi M. Co-infection of Coronavirus Disease 2019 and Influenza A: A Report from Iran. *ARCH IRAN MED*. 2020; **23**(4): 239-243.
13. Wu X, Cai Y, Huang X, et al. Co-infection with SARS-CoV-2 and Influenza A Virus in Patient with Pneumonia, China. *EMERG INFECT DIS*. 2020; **26**(6).
14. Ding Q, Lu P, Fan Y, et al. The clinical characteristics of pneumonia patients coinfecting with 2019 novel coronavirus and influenza virus in Wuhan, China. *J MED VIROL*. 2020.
15. National Health Commission, State Administration of Traditional Chinese Medicine. Diagnosis and Treatment of Protocol of COVID-19.
<http://www.nhc.gov.cn/xcs/zhengcwj/202003/46c9294a7dfe4cef80dc7f5912eb1989.Shtml>, 2020- 03-03..
16. Azekawa S, Namkoong H, Mitamura K, et al. Co-infection with SARS-CoV-2 and influenza A virus. *IDCases*. 2020; **20**: e775.
17. Sha G. Co-infection of SARS CoV-2 and influenza A in a child: a case report. *Henan J Prev Med*. 2020; **31**(05): 323-324.
18. Konala VM, Adapa S, Gayam V, et al. Co-infection with Influenza A and COVID-19. *European Journal of Case Reports in Internal Medicine*. 2020; **7**(5): 1.
19. Goka E, Valley P, Mutton K, Klapper P. Influenza A viruses dual and multiple infections with other respiratory viruses and risk of hospitalisation and mortality. *INFLUENZA OTHER RESP*. 2013; **7**(6): 1079-1087.
20. Meskill SD, Revell PA, Chandramohan L, Cruz AT. Prevalence of co-infection between respiratory syncytial virus and influenza in children. *The American Journal of Emergency Medicine*. 2017; **35**(3): 495-498.
21. Guan W, Ni Z, Hu Y, et al. Clinical Characteristics of Coronavirus Disease 2019 in China. *NEW ENGL J MED*. 2020; **382**(18): 1708-1720.
22. Xu K, Chen Y, Yuan J, et al. Factors associated with prolonged viral RNA shedding in patients with COVID-19. *CLIN INFECT DIS*. 2020.
23. European Centre For Disease Control. Scientific-advice-neuraminidase-inhibitors-2017.
<https://www.ecdc.europa.eu/sites/default/files/documents/Scientific-advice-neuraminidase-inhibitors-2017..>
24. Centers for Disease Control and Prevention. Influenza.
<https://www.cdc.gov/flu/treatment/whatyoushould.htm..>
25. McCullers JA, Bartmess KC. Role of Neuraminidase in Lethal Synergism between Influenza Virus and *Streptococcus pneumoniae*. *The Journal of Infectious Diseases*. 2003; **187**(6): 1000-1009.
26. Arabi YM, Mandourah Y, Al-Hameed F, et al. Corticosteroid Therapy for Critically Ill Patients with Middle East Respiratory Syndrome. *AM J RESP CRIT CARE*. 2018; **197**(6): 757-767.
27. Stockman LJ, Bellamy R, Garner P. SARS: systematic review of treatment effects. *PLOS MED*. 2006; **3**(9): e343.

28. Nowak MD, Sordillo EM, Gitman MR, Paniz Mondolfi AE. Co-infection in SARS-CoV-2 infected Patients: Where Are Influenza Virus and Rhinovirus/Enterovirus? *J MED VIROL*. 2020.
29. Kim D, Quinn J, Pinsky B, et al. Rates of Co-infection Between SARS-CoV-2 and Other Respiratory Pathogens. *JAMA*. 2020.
30. Schultz-Cherry S. Viral Interference: The Case of Influenza Viruses. *J INFECT DIS*. 2015; **212**(11): 1690-1691.

Tables

Table 1 Study samples included in the review

Authors, year, country	Type of study	Specimen for SARS-COV-2	Case number
Original data, 2020, China*	Original data	NP, OP	2
Ding et al., 2020, China ¹⁴	Clinical study	NA	3
Wu et al., 2020, China ¹³	Case report	NP, SP, BALF	1
Khodamoradi et al., 2020, Iran ¹²	Case report	NP, OP	4
Azekawa et al., 2020, Japan ¹⁶	Case report	SP	1
Konala et al., 2020, America ¹⁸	Case report	NP	1
Sha, 2020, China ¹⁷	Case report	OP	1

Abbreviations: NP: nasopharyngeal; OP: oropharyngeal; SP: sputum; BALF: bronchoalveolar lavage fluid. NA: not available.

*data collected from Wuhan Union Hospital.

Table 2 Basic clinical characteristics of the patents in the included studies

Authors	Original data		Ding et al ¹⁴		Wu et al ¹³		Khodamoradi et al ¹²		et al ¹⁶		Konala et al ¹⁸		Sha ¹⁷		Total N(%)
Gender	M	F	F	M	F	M	F	M	M	M	F	F	M	M	7(53.8)
Age (median, IQR)	41	34	47	50	49	69	74	40	64	50	78	66	5	F	6(46.2)
Comorbidities*	Yes	No	No	Yes	No	No	Yes	No	No	No	Yes	Yes	No	S	5(38.5)
Clinical classification	S	Md	Md	S	Md	S	S	Md	S	S	Md	S	Md	Md	6(46.2)
														S	7(53.8)
Symptom															
Fever	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	12(92.3)
Cough	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	13(100)
Dyspnea	Yes	no	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	No	No	10(76.9)
Myalgia	Yes	Yes	Yes	No	Yes	No	Yes	Yes	No	Yes	No	No	No	No	7(53.8)
Fatigue	Yes	Yes	Yes	Yes	No	No	No	No	No	No	No	No	No	No	4(30.8)
Anorexia	Yes	No	No	No	No	No	Yes	No	No	No	Yes	Yes	No	No	4(30.8)
Headache	No	No	Yes	No	Yes	No	Yes	Yes	Yes	No	No	No	No	No	5(38.5)
Nasal tampon	No	Yes	Yes	No	Yes	No	No	No	No	No	No	No	No	No	3(23.1)
Expectoration	No	No	Yes	No	Yes	No	No	No	No	No	Yes	No	No	No	3(23.1)
Pharyngalgia	No	No	Yes	No	Yes	No	No	No	No	No	No	No	No	No	2(15.4)
Chest pain	Yes	No	No	No	Yes	No	No	Yes	No	No	No	No	No	No	3(23.1)
Chill	Yes	No	No	No	No	No	No	Yes	No	No	No	No	No	No	2(15.4)
Diarrhea	No	No	No	No	No	No	No	Yes	No	No	No	No	No	No	1(7.8)

* Comorbidities included hypertension, diabetes, kidney tumor, cerebrovascular disease, coronary artery disease, dyslipidemia, hypothyroidism, pituitary microadenoma, congestive heart failure, Chronic kidney disease.

Abbreviation: M: male; F: female; Md: moderate; S: severe.

Table 3 Clinical course of the patents in the included studies

Authors	Original data		Ding et al ¹⁴			Wu et al ¹³	Khodamoradi et al ¹²				Azekawa et al ¹⁶	Konala et al ¹⁸	Sh ¹⁷	Total N (%)
Days from symptom onset to hospital admission (median, IQR)	4	11	NA	NA	NA	7	5	4	5	2	5	3	2	4.5(2.75,5.5)
Decreased lymphocyte count on admission	Yes	No	Yes	Yes	No	Yes	Yes	No	No	Yes	No	Yes	Yes	8/13(61.5)
Abnormal radiological changes* (%)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	13/13(100)
SpO ₂ ≤93% on admission	Yes	No	NA	NA	NA	Yes	Yes	No	Yes	Yes	No	Yes ^Δ	No	6/10(60)
Days in hospital (median, IQR)	20	17	14	30	19	NA	NA	NA	NA	NA	16	NA	15	17(15,20)
Treatment														
Oseltamivir	Yes	Yes	Yes	Yes	Yes	Yes	NA	NA	NA	NA	Yes	No	Yes	8/9(88.9)
Antiviral therapy (except Oseltamivir)	Yes	Yes	Yes	Yes	Yes	NA	NA	NA	NA	NA	No	Yes	Yes	7/8(87.5)
Antibiotic therapy	Yes	Yes	Yes	Yes	Yes	NA	NA	NA	NA	NA	Yes	Yes	Yes	8/8(100)
Corticosteroid therapy	No	No	Yes	Yes	No	NA	NA	NA	NA	NA	No	No	Yes	3/8(37.5)
Oxygen inhalation	Yes	No	Yes	Yes	Yes	Yes	NA	NA	NA	NA	No	Yes	No	6/9(66.7)
Clinical events														
Acute liver injury	No	No	Yes	Yes	No	NA	NA	NA	NA	NA	No	No	No	2/8(25)
Acute respiratory distress syndrome	No	No	No	Yes	No	Yes	NA	NA	NA	NA	No	No	No	2/9(22.2)
Noninvasive ventilation	No	No	No	Yes	No	No	NA	NA	NA	NA	No	No	No	1/9(11.1)
Endotracheal intubation	No	No	No	No	No	Yes	NA	NA	NA	NA	No	Yes	No	2/9(22.2)
Intensive care unit	No	No	No	No	No	Yes	NA	NA	NA	NA	No	Yes	No	2/9(22.2)
Clinical outcome	D	D	D	D	D	T	NA	NA	NA	NA	D	NA	D	--

Abbreviations: NA: not available; D: discharged; T: transferred

* the first chest CT or X ray after admission

^Δoxygen saturation of 91% on a nasal cannula with a flow rate of 2 l/min.

Supplemental Information

Supplementary 1 Data information

Supplementary Files

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