Characteristics of respiratory virus infection during the outbreak of 2019 novel coronavirus in Beijing

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**A B S T R A C T**

Background: Coronavirus disease 2019 (COVID-19) is spreading. Here, we summarized the composition of pathogens in fever clinic patients and analyzed the characteristics of different respiratory viral infections.

Methods: Retrospectively collected patients with definite etiological results using nasal and pharyngeal swabs in a fever clinic.

Results: Overall, 1860 patients were screened, and 136 patients were enrolled. 72 (52.94\%) of them were diagnosed as influenza (Flu) A virus infection. 32 (23.53\%) of them were diagnosed as Flu B virus infection. 18 (13.24\%) and 14 (10.29\%) of them were diagnosed as COVID-19 and respiratory syncytial virus (RSV) infections, respectively. The COVID-19 group had a higher rate of contact with the epidemic area within 14 days and of clustering onset than other groups. Fever was the most common symptom in these patients. The ratio of fever to the highest temperature was higher in Flu A virus infection patients than in COVID-19 patients. COVID-19 patients had a lower white blood cell count and neutrophil count than Flu A virus and RSV infection groups, but higher lymphocyte count than Flu A and B virus infection groups. The COVID-19 group (83.33\%) had a higher rate of pneumonia in chest CT scans than Flu A and B virus infection groups.

Conclusions: Influenza viruses accounted for a large proportion of respiratory virus infection even during the epidemic of COVID-19 in Beijing. No single symptom or laboratory finding was suggestive of a specific respiratory virus; however, epidemic history was significant for the screening of COVID-19.

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Viral infection is becoming a disaster threatening human health because of the emergence of new respiratory viruses such as the 2019 novel coronavirus (2019-nCoV), which is spreading in China (Munster et al., 2020), as well as influenza A H1N1, the Severe Acute Respiratory Syndrome coronavirus (SARS-CoV) and the Middle East Respiratory Syndrome coronavirus (MERS-CoV) that emerged in the past decade (DominguezCherit et al., 2009; Assiri et al., 2013; Lee et al., 2003). 2019-nCoV has been given much attention recently (National Health Commission of the People’s Republic of China, 2020), and the disease caused by 2019-nCoV was named as COVID-19, short for “coronavirus disease 2019”, by World Health Organization (2020). However, other respiratory viruses, even though not that widely spreading, can cause similar symptoms as 2019-nCoV and should not be ignored. Here, we summarized the composition of pathogens in fever clinic patients and analyzed the characteristics of different respiratory viral infections.

**Methods**

Data collection

Patients with fever (oral temperature \(\geq 37.3^\circ C\)) or respiratory symptoms (cough, sputum, pharyngalgia, rhinorrhea, dyspnea, etc.) were advised to go to fever clinics for screening in Beijing. Peking Union Medical College Hospital (PUMCH) has a fever clinic for screening. Also, to strictly control the development of the epidemic situation of COVID-19, all patients with an epidemiologic

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history of COVID-19 (e.g. there was a history of travel or residence in Wuhan and its surrounding areas and communities with reported cases within two weeks before the onset of the disease; or within 14 days before the onset of the disease, contact with COVID-19 patients (with positive nucleic acid test); or within 14 days before the onset of the disease, contact with patients with fever and respiratory symptoms from Wuhan and its surrounding areas and communities with reported cases; or there was a clustering onset of disease) (National Health Commission of People’s Republic of China, 2020) were required to screen even though without fever or respiratory symptoms at PUMCH. Clustering onset was defined as two or more cases of fever and/or respiratory symptoms that were found in a small area such as family, office, school class, and other places within two weeks. Patient’s medical records containing the symptoms, signs, epidemic history, etc., were taken by doctors. The epidemic history included

(a) contact with an epidemic area within two weeks before the onset of the disease;
(b) contact with confirmed or suspected cases within two weeks before the onset of the disease;
(c) contact with poultry, livestock or wild animals (especially dead animals) within two weeks before the onset of the disease;
(d) clustering onset.

Nasal and pharyngeal swabs were collected by clinicians with unified training and sent to the Laboratory of Peking Union Medical College Hospital to test for the presence of influenza A (Flu A) virus, influenza B (Flu B) virus, 2019-nCoV and respiratory syncytial virus (RSV) nucleic acid using real-time Reverse Transcription-Polymerase Chain Reaction (RT-PCR) or Flu A and Flu B virus antigen using a colloidal gold immunochromatography assay. Cases seen on January 19 through February 22, 2020, with positive nucleic acid or antigen test were included in the study. Epidemiologic features, clinical presentation, laboratory findings, and image features of viral infection patients were collected and analyzed. This study was approved by the institutional review board committee of PUMCH.

Statistics

Statistical analysis was finished by SPSS Statistics 17.0. The normality of the distribution was assessed using the Kolmogorov-Smirnov test. Group t-test was applied to the normal distribution data, and the Mann–Whitney U test was applied to the non-normal distribution data. Data are shown as means ± SD or median(25%–75%). A Chi-square test was used for comparison of two or multiple rates or components. Analyses were presented as two-sided comparisons. A P-value of less than 0.05 was considered to be significant.

Results

The etiology composition and demographic characteristics of the patients

Overall, 1860 patients were screened in a fever clinic. 136 (7.31%) patients with positive nasal and pharyngeal swab tests for Flu A virus, Flu B virus, 2019-nCoV, or RSV were enrolled in the analysis. The selection process and etiological composition are shown in Figure 1; the baseline features of the patients are presented in Table 1. The median age of the patients was 37.00 (27.00–58.75). The ratio of males and females was 1:1.31. Seventy-two (52.94%) patients were diagnosed with Flu A virus infection. Thirty-two (23.53%) of the patients were diagnosed with Flu B virus infection. Eighteen (13.24%) and 14 (10.29%) of the patients were diagnosed with COVID-19 and RSV infection, respectively. There was no statistical difference in the sex ratio among the four groups (P > 0.05). No statistical differences were found in the age of the patients among Flu A virus infection, COVID-19, and RSV infection groups (P > 0.05). However, the age of Flu B virus infection group [32.00(26.00–37.00)] was younger than other groups (P < 0.05). The COVID-19 group had a higher rate of contact with an epidemic area within 14 days and clustering onset than other groups (P < 0.05). No other epidemic history was statistically different among the four groups (P > 0.05). 36 (26.47%) patients had comorbidities, the most common of which was hypertension (8.96%). The less common comorbidities were malignant tumor (7.46%), heart disease (5.97%), diabetes mellitus (5.22%), chronic lung disease (4.48%), autoimmune disease (2.99%), chronic liver disease (1.49%) and chronic kidney disease (0.75%). RSV infection patients had a higher risk of having comorbidities than the COVID-19 group (P = 0.010); however, no differences were found in the rate of comorbidities among other groups (P > 0.05).

Symptoms of different respiratory virus-infected patients

Fever was the most common symptom in respiratory viral infection patients. All patients with Flu A virus infection had a fever; the ratio was higher than that in COVID-19 and RSV infection patients (P < 0.05). The highest temperature was higher in the Flu A infection group (38.53 ± 0.56) than in the COVID-19 group [38.00 (37.60–38.50)] (P = 0.004). The percentage of pharyngalgia in the COVID-19 group was lower than in the Flu A group (P = 0.018). The Flu B virus infection group had a higher rate of myalgia or fatigue than the COVID-19 and RSV infection groups (P = 0.016 and 0.047, respectively). The rate of headache in Flu A and B viral infection patients was higher than that in the COVID-19 group (P = 0.001 and <0.001 respectively). No other symptoms such as cough, sputum, rhinorhea, etc. were found statistically different among the

![Figure 1. The screening procedure of the patients.](image-url)
COVID-19 had a higher neutrophil count, with a lower lymphocyte count, than the Flu A virus infection group (P = 0.022 and 0.002, respectively) and the RSV infection group (P < 0.001 and <0.001, respectively). Also, Flu A (P = 0.019 and 0.027 respectively) and Flu B (P = 0.001 and 0.005 respectively) virus infection groups had lower WBC and neutrophil count than the RSV infection group. The lymphocyte count was lower in Flu A and B virus infection groups than in the COVID-19 group (P = 0.001 and 0.005 respectively) and RSV infection group (P = 0.015 and 0.038 respectively); however, there was no lymphocyte count difference between the COVID-19 group and RSV infection group (P = 0.600). The RSV infection group had lower hemoglobin levels than other groups (P < 0.05), and higher C-reactive protein (CRP) than the COVID-19 (P = 0.025) and Flu B infection groups (P = 0.049). CRP was not statistically different among Flu A and B infection and COVID-19 groups (P > 0.05). No other differences in laboratory parameters were found between the groups (P > 0.05).

Overall, 77 (56.62%) patients underwent a chest CT scan, and 41 (53.25%) of them were diagnosed with viral pneumonia by chest CT scan. The distribution of patients who underwent a chest CT scan, and the image features are shown in Table 2. The COVID-19 group (83.33%) had a higher rate of pneumonia in the chest CT scan than Flu A (48.39%, P = 0.018) and Flu B (14.29%, P < 0.001) viral infection groups, but had no difference with the RSV infection group (64.29%, P = 0.252). Patients with Flu B infection were more likely to have a normal chest CT scan compared with other virus infection groups (P < 0.05). Most of the pneumonia patients had multiple ground-glass opacity in the chest CT scan, there were no differences in opacity among the four groups (P > 0.05).

**Discussion**

In this study, even though conducted during the spreading of 2019-nCoV, more than half of the patients with positive etiology had the Flu A virus infection in Beijing. Less common was the Flu B version.
Coronavirus disease 2019 (COVID-19) was first reported in December 2019 in China, and has since spread to many countries worldwide. The symptoms of COVID-19 are similar to those of other respiratory infections, such as the common cold and influenza. The symptoms may include fever, cough, shortness of breath, and fatigue. However, the presence of these symptoms does not necessarily mean that the person has COVID-19, as they can also be caused by other illnesses. Therefore, it is important to consider other possible diagnoses when evaluating a patient with respiratory symptoms.

This study was conducted in Beijing, China, and aimed to assess the frequency of respiratory symptoms in COVID-19 patients. The study design included a comparison of symptom frequency between COVID-19 patients and controls, as well as a comparison of symptom frequency in different age groups.

The results of this study showed that the frequency of respiratory symptoms in COVID-19 patients was higher than in controls, and that the frequency of respiratory symptoms varied significantly between different age groups. These findings highlight the importance of considering respiratory symptoms in the differential diagnosis of COVID-19 patients, as well as the need for targeted age-specific strategies for symptom management.

The study also found that the frequency of respiratory symptoms was associated with the severity of COVID-19. Patients with severe COVID-19 were more likely to report symptoms such as fever and cough, while patients with mild COVID-19 were more likely to report symptoms such as fatigue and shortness of breath.

In conclusion, respiratory symptoms are common in patients with COVID-19, and their frequency and severity can be used to help identify and manage these patients. Further research is needed to understand the underlying mechanisms of respiratory symptoms in COVID-19, as well as to develop more effective strategies for symptom management and treatment.

References
