Clinical features of 375 COVID-19 cases imported from Russia through the Suifenhe port and countermeasures

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Abstract

Background and objectives
At present, the focus of the fighting against COVID-19 in China is shifting to strictly prevent the entrance of cases from abroad and disease transmission. Therefore, it is extremely urgent to better understand the clinical features of imported cases from overseas countries, which is conducive to formulate the corresponding countermeasures. This study aimed to describe the clinical features of COVID-19 cases imported from Russia through the Suifenhe port, in order to identify baseline and clinical data associated with disease progression and present corresponding countermeasures.

Methods
All COVID-19 cases imported from Russia through the Suifenhe port were included in this retrospective study. According to the “Diagnosis and Treatment Protocol for Novel Coronavirus Pneumonia (seventh edition)”, imported COVID-19 cases were divided into asymptomatic infection, mild, moderate, severe, and critical groups. Baseline and clinical data, including age, gender, comorbidities, disease severity, symptoms at onset, body temperature, white blood cell (WBC) count, lymphocyte (LYM) count, lymphocyte percentage (LYM%), C-reactive protein (CRP), oxygenation index (OI), and the use therapeutic modalities were obtained on admission, and then compared between groups.

Results
A total of 375 COVID-19 cases imported from Russia through Suifenhe port were included, of whom the asymptomatic infection, mild, moderate, severe, and critical groups accounted...
for 4.0%, 13.9%, 75.5%, 5.3%, and 1.3%, respectively. The majority of the imported COVID-19 cases were men (61.9%) with a median age of 38.72 years who had no comorbidity (87.7%). Nearly one-third of them (33.1%) were asymptomatic at onset, and common initial symptoms included fever (36.5%), cough (36.0%), pharyngeal discomfort (12.3%), expectoration (8.0%), and chest tightness (5.3%). In total, 180 (48%) and 4 (1.1%) enrolled imported cases received nasal tube oxygen inhalation therapy and high-flow oxygen absorption, respectively; the remaining patients did not undergo oxygen therapy. The values of age, body temperature, WBC, LYMPH, LYM%, CRP, and OI were 38.72 ± 10.50, 35.10 ± 7.92, 5.59 ± 1.97, 1.67 ± 0.68, 31.05 ± 10.22, 8.00 ± 14.75, and 389.03 ± 74.07, respectively. Gender, age, LYMPH, LYM%, symptoms at onset, cough, fever, other rare symptoms, and oxygen therapy showed significant differences between groups (P = 0.036, < 0.001, < 0.001, < 0.001, < 0.001, < 0.001, < 0.001, = 0.045, < 0.001, respectively).

Conclusions

Compared with domestic confirmed patients, COVID-19 patients who arrived at China from Russia through the Suifenhe port had significantly different clinical features, and the differences in gender, age, LYMPH, LYM%, symptoms at onset, cough, fever, other rare symptoms, and oxygen therapy between groups were statistically significant. Therefore, detailed and comprehensive countermeasures were developed to manage and prevent another outbreak based on these clinical features.

Introduction

Coronavirus disease 2019 (COVID-19) is wreaking havoc around the world, with the mutations of severe acute respiratory syndrome coronavirus type 2 (SARS-CoV-2) aggravating the current situation even more [1, 2]. Coronavirus disease 2019 (COVID-19) outbreak has been far more devastating than expected, showing no signs of slowing down at present. COVID-19 has led to more deaths than the sum of severe acute respiratory syndrome CoV (SARS-CoV) and Middle East respiratory syndrome CoV (MERS-CoV). The case-fatality rate of COVID-19 as reported previously varied from 3.77% to 28% in Wuhan (epicenter area) [3–10], and this percentage was significantly higher than that in other non-epicenter areas of China [9, 11]. COVID-19 is spreading and wreaking havoc worldwide, especially in the United States and Europe [12], imposing huge challenges to healthcare systems and economic development. As the number of domestic confirmed cases continue to decline, the prevention and control of COVID-19 are on the verge of victory in China. For the next step, the focus of epidemic prevention and management has been shifted to the strict prevention of imported cases from abroad, however, little is known about the clinical features of imported COVID-19 cases from overseas countries. With the surge of returnees from overseas, this task has become extremely arduous, especially at the Suifenhe port, the only remaining Sino-Russian land port in Heilongjiang province (China), which has a long history and resident population of only 70,000. Several national and provincial experts and medical teams have rushed to Suifenhe and Mudanjiang to relieve medical stress.

With the increasing number of cases imported from Russia through the Suifenhe port, it is highly essential to understand the clinical features of such cases, identify baseline and clinical data associated with disease progression, and formulate corresponding countermeasures to
prevent the spread of COVID-19. The comparison of imported cases with differences in disease severity can result in identification of baseline and clinical data associated with disease progression to facilitate the early diagnosis and intervention of risky imported patients, and thereby reduce the incidence of severe or critical cases. Previous research showed that the mortality rate of critically ill COVID-19 patients even reached 60% [13]. Although the recent increase of imported cases from Russia slowed down due to the temporary closure of the Suifenhe port, an improper response may result in disastrous consequences.

This study aimed to describe clinical features of COVID-19 cases imported from Russia through the Suifenhe port, identify baseline and clinical data associated with disease progression, and present corresponding countermeasures based on findings of this study.

**Methods**

**Study design**

This retrospective study included all imported COVID-19 cases from Russia through the Suifenhe port who were treated in Suifenhe square cabin hospital, Mudanjiang Ankang hospital, and Hongqi Hospital Affiliated Mudanjiang Medical University due to differences in disease severity. According to the "Diagnosis and Treatment Protocol for Novel Coronavirus Pneumonia (seventh edition)", imported COVID-19 cases were divided into asymptomatic infection, mild, moderate, severe, and critical groups. Baseline and clinical data were collected on admission and then compared between groups. This study was approved by the Ethics Committee of the First Affiliated Hospital of Harbin Medical University (Harbin, China). The informed consent was waived by the ethics committee for the observational and retrospective nature.

**Study population**

In this retrospective study, the inclusion criterion was confirmed as imported COVID-19 cases from Russia through the Suifenhe port. All enrolled imported COVID-19 patients were addressed using similar treatment regimens according to the "Diagnosis and Treatment Protocol for Novel Coronavirus Pneumonia (seventh edition)".

**Diagnosis of COVID-19**

All enrolled imported cases were diagnosed as severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection via nasopharyngeal swab nucleic acid amplification testing.

**Data acquisition**

Baseline and clinical data, including age, gender, comorbidity, disease severity, symptoms at onset, body temperature, WBC, LYMPH, LYM%, CRP, OI on admission and therapeutic modalities, were collected from medical records. The members of our research team were blinded to patients’ personal data beyond the baseline and clinical data required for this study.

**Statistical analysis**

SPSS 23.0 software (IBM, Armonk, NY, USA) was used to perform statistical analyses. The quantitative data were described as the mean ± standard deviation (SD), while the qualitative data were expressed as number. If the qualitative data met the predefined requirement, $\chi^2$ test was utilized; otherwise, the Fisher’s exact test was employed. Bonferroni correction test was used for making inter-group comparison. One-way analysis of variance (ANOVA) was employed for the comparison of normally distributed data between two groups, while the
Kruskal-Wallis rank-sum test was utilized for comparing abnormally distributed data. Intergroup comparisons were made by using the least significant difference (LSD) method. P-value < 0.05 was considered statistically significant.

**Results**

**Patients’ demographic and clinical characteristics**

As shown in Table 1, a total of 375 imported COVID-19 cases from Russia through the Suifenhe port were included, of whom asymptomatic infection, mild, moderate, severe, and critical groups accounted for 4.0%, 13.9%, 75.5%, 5.3%, and 1.3%, respectively. The majority of the imported COVID-19 patients were men (61.9%), with a median age of 38.72 years old without comorbidity (87.7%). Imported cases with 1, 2, 3, and 4 types of comorbidities accounted for 10.1%, 1.1%, 0.8%, and 0.3% of the patients, respectively. Common comorbidities included hypertension (5.9%), diabetes (2.7%), coronary artery disease (1.6%), and hepatitis B virus (1.1%). Nearly one-third of imported patients (33.1%) were asymptomatic at onset, and common initial symptoms included fever (36.5%), cough (36.0%), pharyngeal discomfort (12.3%), expectoration (8.0%), and chest tightness (5.3%). In total, 180 (48%) and 4 (1.1%) enrolled

| Characteristic | Classification | Frequency | Percentage |
|---------------|----------------|-----------|------------|
| Disease severity | Asymptomatic infection | 15 | 4.0 |
|                | Mild            | 52 | 13.9 |
|                | Moderate        | 283 | 75.5 |
|                | Severe          | 20 | 5.3 |
|                | Critical        | 5 | 1.3 |
| Gender         | Female          | 143 | 38.1 |
|                | Male            | 232 | 61.9 |
| Number of comorbidities | 0.00 | 329 | 87.7 |
|                | 1.00            | 38 | 10.1 |
|                | 2.00            | 4 | 1.1 |
|                | 3.00            | 3 | 0.8 |
|                | 4.00            | 1 | 0.3 |
| Symptoms at onset | No              | 124 | 33.1 |
|                | Yes             | 251 | 66.9 |
| Cough          | No              | 240 | 64.0 |
|                | Yes             | 135 | 36.0 |
| Fever          | No              | 238 | 63.5 |
|                | Yes             | 137 | 36.5 |
| Expectoration  | No              | 345 | 92.0 |
|                | Yes             | 30 | 8.0 |
| Pharyngeal discomfort | No      | 329 | 87.7 |
|                | Yes             | 46 | 12.3 |
| Chest tightness | No              | 355 | 94.7 |
|                | Yes             | 20 | 5.3 |
| Other rare symptoms | No           | 297 | 79.2 |
|                | Yes             | 78 | 20.8 |
| Oxygen therapy | None            | 186 | 49.6 |
|                | Nasal tube oxygen inhalation therapy | 180 | 48.0 |
|                | High-flow oxygen absorption | 4 | 1.1 |

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imported patients received nasal tube oxygen inhalation therapy and high-flow oxygen absorption, respectively; the remaining patients did not obtain oxygen therapy. The values of age, body temperature, WBC, LYMPH, LYM%, CRP, and OI were $38.72 \pm 10.50$, $35.10 \pm 7.92$, $5.59 \pm 1.97$, $1.67 \pm 0.68$, $31.05 \pm 10.22$, $8.00 \pm 14.75$, and $389.03 \pm 74.07$, respectively (Table 2).

### Comparison of imported COVID-19 cases with different levels of disease severity

As summarized in Table 3, an inter-group comparison showed that the proportion of male patients in the asymptomatic infection group was higher than that in the mild group ($P = 0.036$). As shown in Tables 3 and 4, the differences in age between groups were statistically significant ($P < 0.001$), except for the asymptomatic infection and mild groups, indicating that age increased as the disease progressed. The differences in LYMPH between groups were statistically significant ($P < 0.001$), except for the mild and moderate groups, manifesting that LYMPH decreased as the disease progressed. LYM% in the critical and severe groups was significantly lower than that in the asymptomatic infection, mild, and moderate groups ($P < 0.001$). As presented in Table 5, cough, fever, and oxygen therapy showed significant differences between groups ($P < 0.001$, $< 0.001$, $< 0.001$, respectively). The differences in symptoms at onset between groups were statistically significant ($P < 0.001$), except for the moderate group and the critical or severe group, reflecting the enhancement of symptoms at onset as the disease progressed. The incidence of other rare symptoms in critical or severe group was significantly higher than that in mild group ($P = 0.045$).

### Discussion

COVID-19 has been confirmed to be caused by SARS-CoV-2 infection [14] and has complex clinical manifestations ranging from asymptomatic infection to fatal critical illnesses that

![Table 2. Demographic and clinical data of imported COVID-19 cases from Russia through the Suifenhe port.](https://doi.org/10.1371/journal.pone.0261437.t002)

|              | N   | Min | Max | Mean | SD  | P25  | P50  | P75  |
|--------------|-----|-----|-----|------|-----|------|------|------|
| Age          | 375 | 14.00 | 66.00 | 38.72 | 10.50 | 31.00 | 39.00 | 47.00 |
| Body temperature | 375 | 35.50 | 39.50 | 35.10 | 7.92  | 36.30 | 36.60 | 37.10 |
| WBC          | 375 | 0.36  | 4.55  | 1.67  | 0.68  | 1.23  | 1.58  | 2.05  |
| LYMPH        | 375 | 3.63  | 64.90 | 31.05 | 10.22 | 23.90 | 30.90 | 38.30 |
| LYM%         | 375 | 1.70  | 105.04 | 8.00  | 14.75 | 1.70  | 1.70  | 7.80  |
| CRP          | 372 | 6.00  | 666.00 | 389.03 | 74.07  | 362.25 | 398.00 | 428.00 |

![Table 3. Comparison of gender, comorbidities, age, LYMPH, and LYM% between groups with different levels of disease severity.](https://doi.org/10.1371/journal.pone.0261437.t003)

| Gender      | Asymptomatic infection (N = 15) | Mild (N = 52) | Moderate (N = 283) | Critical or Severe (N = 25) | X2   | P  |
|-------------|---------------------------------|--------------|--------------------|-----------------------------|------|----|
| Female      | 1                               | 25           | 108                | 9                           | 8.523| 0.036|
| Male        | 14                              | 27           | 175                | 16                          |      |    |
| Comorbidities | No                       | 14           | 45                 | 251                         | 19   | 3.366| 0.282|
|             | Yes                              | 1            | 7                  | 32                          | 6    |    |
| Age (years old) | 30.67 ± 8.85 | 34.81 ± 9.20 | 39.27 ± 10.42abc | 45.56 ± 9.53abc            | 9.782| <0.001|
| LYMPH       | 2.49 ± 0.49                     | 1.84 ± 0.68a | 1.66 ± 0.63a       | 0.88 ± 0.44abc             | 23.661| <0.001|
| LYM (%)     | 35.85 ± 5.72                    | 32.81 ± 9.23 | 31.80 ± 9.69       | 15.96 ± 7.61abc            | 24.082| <0.001|

a, b and c represent significant differences compared with the asymptomatic infection, mild, and moderate groups, respectively.

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mostly present as acute respiratory distress syndrome (ARDS) and require mechanical ventilation support [15, 16]. An excessive and uncontrolled response to SARS-CoV-2 infection can induce injury or failure of different vital organs in the clinic. At present, COVID-19 is mainly diagnosed by real-time polymerase chain reaction (RT-PCR) detection of SARS-CoV-2 nucleic acids on oropharyngeal and/or nasopharyngeal swabs [17, 18], although there is a certain probability of false-positive and false-negative results [19–21]. If two consecutive negative results on a respiratory nucleic acid test (at an interval of at least 24 h) are used as the exclusion criteria, the results of RT-PCR measurement are further used to judge the clinical severity of COVID-19. For the convenience of clinical management, the severity of COVID-19 is divided into mild, moderate, and critical or severe, with the criteria provided in Table 4. Inter-group comparisons of age, LYM, and LYM% between groups with different levels of disease severity.

| Dependent variable | (I) Group | (J) Group | Mean difference (I-J) | Standard error | Significance | 95% confidence interval | Lower limit | Upper limit |
|--------------------|-----------|-----------|-----------------------|----------------|--------------|-------------------------|------------|------------|
| Age (years old)    | Asymptomatic infection | Mild | -4.14103 | 2.97445 | .165 | 9.9899 | 1.7079 |
|                    | Moderate | -8.59835 | 2.68897 | .002 | 13.8859 | -3.3108 |
|                    | Critical or Severe | -14.89333 | 3.31460 | .000 | 21.4111 | 8.3756 |
|                    | Mild | 4.14103 | 2.97445 | .165 | -1.7079 | 9.9899 |
|                    | Moderate | -4.45733 | 1.53124 | .004 | -7.4683 | -1.4463 |
|                    | Critical or Severe | -10.75031 | 2.46996 | .000 | -15.6092 | -5.8954 |
| Moderate           | Asymptomatic infection | Mild | 8.59835 | 2.68897 | .002 | 3.3108 | 13.8859 |
|                    | Moderate | 4.45733 | 1.53124 | .004 | 1.4463 | 7.4683 |
|                    | Critical or Severe | -6.29498 | 2.11753 | .003 | -10.4588 | -2.1311 |
| Critical or Severe | Asymptomatic infection | Mild | 14.89333 | 3.31460 | .000 | 8.3756 | 21.4111 |
|                    | Moderate | 10.75231 | 2.46996 | .000 | 5.8954 | 15.6092 |
|                    | Critical or Severe | 6.29498 | 2.11753 | .003 | 2.1311 | 10.4588 |
| LYMPH              | Asymptomatic infection | Mild | .65218 | .18231 | .000 | .2937 | 1.0107 |
|                    | Moderate | .83093 | .16482 | .000 | .5068 | 1.1550 |
|                    | Critical or Severe | 1.61733 | .20316 | .000 | 1.2178 | 2.0168 |
| Mild               | Asymptomatic infection | Mild | -.65218 | .18231 | .000 | -1.0107 | -2.937 |
|                    | Moderate | .17875 | .09386 | .058 | .0058 | .3633 |
|                    | Critical or Severe | .96515 | .15139 | .000 | .6675 | 1.2628 |
| Moderate           | Asymptomatic infection | Mild | -.83093 | .16482 | .000 | -1.1550 | -5.068 |
|                    | Moderate | -.17875 | .09386 | .058 | -.3633 | .0058 |
|                    | Critical or Severe | .78640 | .12979 | .000 | .5312 | 1.0416 |
| Critical or Severe | Asymptomatic infection | Mild | -1.61733 | .20316 | .000 | -2.0168 | -1.2178 |
|                    | Moderate | -.96515 | .15139 | .000 | -1.2628 | -6.667 |
|                    | Critical or Severe | -.78640 | .12979 | .000 | -1.0416 | -.5312 |
| LYM (%)            | Asymptomatic infection | Mild | 3.03705 | 2.75009 | .270 | 2.3070 | 8.4448 |
|                    | Moderate | 4.04349 | 2.48614 | .105 | -.8452 | 8.9322 |
|                    | Critical or Severe | 19.88857 | 3.06458 | .000 | 13.8625 | 25.9148 |
| Mild               | Asymptomatic infection | Mild | -3.03705 | 2.75009 | .270 | -8.4448 | 2.3707 |
|                    | Moderate | 1.00644 | 1.41574 | .478 | -1.7774 | 3.7903 |
|                    | Critical or Severe | 16.85162 | 2.28365 | .000 | 12.3611 | 21.3421 |
| Moderate           | Asymptomatic infection | Mild | -4.04349 | 2.48614 | .105 | -8.9322 | .8452 |
|                    | Moderate | -1.00644 | 1.41574 | .478 | -3.7903 | 1.7774 |
|                    | Critical or Severe | 15.84518 | 1.95780 | .000 | 11.9954 | 19.6950 |
| Critical or Severe | Asymptomatic infection | Mild | -19.88867 | 3.06458 | .000 | -25.9148 | -13.8625 |
|                    | Moderate | -16.85162 | 2.28365 | .000 | -21.3421 | -12.3611 |

* Indicates significance at the 5% level

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criterion, this may lead to missed diagnoses in approximately 10% of COVID-19 patients and the spread of the epidemic [22]. SARS-CoV-2 is characterised by its high infectivity, mainly through efficient human-to-human transmission [3, 8, 23, 24], especially among close contacts in closed environments. Since the Suifenhe port is the only remaining Sino-Russian land port in Heilongjiang province, it takes a long-time for returnees to return home by different modes of transportation, providing opportunities for infection with SARS-CoV-2.

To date, few studies have concentrated on foreign imported COVID-19 cases in China [24]. On April 2, 2020, four COVID-19 cases imported from Russia through the Suifenhe port were first confirmed. Since then, the number of patients has soared. For all patients with imported COVID-19 in the current study, their main occupations were as businessmen, students, migrant workers, and freelancers. Inevitably, different host characteristics will lead to different clinical features in the clinic. Huang et al. reported that 20 (49%) of the SARS-CoV-2-infected patients were aged 25–49 years, and 14 (34%) were aged 50–64 years, but Chen et al. reported that the mean age of the 99 patients was 55 ± 5 years. The median age of the COVID-19 patients was 49 ± 0 years (IQR 41 ± 0–58 ± 0) [3, 4]. However, from our study we can see that imported COVID-19 cases from Russia through the Suifenhe port were younger, with a median age of 38.72 years old, and had similar gender proportion and fewer comorbidities. The majority of the imported COVID-19 patients were men (61.9%) and had no comorbidities (87.7%). Rare comorbidities included chronic bronchitis (0.5%), chronic pharyngitis (0.5%), arrhythmia (0.5%), superficial gastritis (0.3%), nephritis (0.3%), chronic enteritis (0.3%), anxiety disorder (0.3%), acute lymphoblastic leukaemia (0.3%), thyroid carcinoma (0.3%), hypothyroidism (0.3%), cerebral infarction (0.3%), psoriasis (0.3%), and chronic urticaria (0.3%). The high proportion of asymptomatic carriers at onset (33.1%) in the present study indicated a remarkable difficulty in identification of SARS-CoV-2 infection patients only based on body temperature and chief complaints without further tests [2]. Available evidence showed that asymptomatic carriers, as a concern for prevention and control of COVID-19, were infectious to an extent.

Symptoms observed at onset were variable. In addition to common symptoms, other rare initial symptoms included diarrhoea (4.53%), nasal congestion (2.93%), shortness of breath (2.40%), fatigue (2.13%), muscle soreness (1.33%), runny nose (1.33%), headache (1.33%),

| Table 5. Comparison of symptoms at onset and oxygen therapy between groups with different levels of disease severity. |
|---------------------------------------------------------------|
| Symptoms at onset | Mild | Moderate | Critical or Severe | $\chi^2$ | $P$ |
| No | 31 | 76 | 2 | 28.469 | <0.001 |
| Yes | 21 | 207 | 23 | |
| Cough | No | 44 | 173 | 8 | 21.000 | <0.001 |
| Yes | 8 | 110 | 17 | |
| Fever | No | 47 | 169 | 7 | 30.657 | <0.001 |
| Yes | 5 | 114 | 18 | |
| Expectoration | No | 50 | 260 | 20 | 5.122 | 0.059 |
| Yes | 2 | 23 | 5 | |
| Pharyngeal discomfort | No | 42 | 249 | 23 | 2.416 | 0.289 |
| Yes | 2 | 34 | 2 | |
| Chest tightness | No | 50 | 268 | 22 | 2.317 | 0.308 |
| Yes | 2 | 15 | 3 | |
| Other rare symptoms | No | 44 | 223 | 15 | 6.169 | 0.045 |
| Yes | 8 | 60 | 10 | |
| Oxygen therapy | No | 45 | 126 | 0 | 54.798 | <0.001 |
| Yes | 7 | 152 | 25 | |

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smell and/or taste disorder (1.33%), palpitiation (0.80%), nausea (0.80%), panting (0.80%),
shiver (0.53%), dizziness (0.53%), sneezing (0.53%), anorexia (0.27%), throat sore (0.27%), pec-
toralgia (0.27%), vomiting (0.27%), somnolence (0.27%), dyspnoea (0.27%), and general dis-
comfort (0.27%). The incidence of symptoms at onset, fever, cough, and other rare symptoms
significantly increased with disease progression. SARS-CoV-2 triggered a high prevalence of
pneumonia rather than upper respiratory symptoms in infected patients, which was consistent
with the results of the current study, due to the dense distribution of angiotensin-converting
enzyme 2 (ACE2), a cellular receptor, in the lower respiratory tract. It is noteworthy that smell
and/or taste disorders (STDs) are extremely frequent among overseas COVID-19 patients
[25–27], even as a marker for SARS-CoV-2 infection [28], while those are rare in domestic
patients. However, the underlying mechanism has still remained elusive. Due to high expres-
sions of ACE2 receptors in gastrointestinal epithelial cells, diarrhoea had become the most
common digestive symptom in COVID-19 patients [29, 30]. The replication of SARS-CoV-2
in the gastrointestinal tract should be given more attention in epidemic prevention to avoid its
spread through the faecal-oral route.

Of all 375 imported cases from Russia through the Suifenhe port, the proportions of severe
and critical patients were lower, accounting for 5.3% and 1.3%, respectively. Therefore, only
approximately half of the patients received oxygen therapy, with nasal tube oxygen inhalation
therapy accounting for the majority. The proportion of cases who received oxygen therapy in
each group significantly increased with deterioration of the disease. Further analysis revealed
that age, LYMPH, and LYM% were correlated to disease progression, with significantly ele-
vated age and decreased levels of LYMPH and LYM% as the disease progressed. As a result,
these factors can be used to determine disease severity in clinical practice.

The major limitation of the current study was the relatively small sample size, with inclu-
sion of a total of 375 cases, all of which were imported from Russia, which may not represent
the clinical features of all imported COVID-19 cases from overseas countries. Therefore, large-
sample datasets of imported COVID-19 cases from different overseas countries are required to
verify our findings. Our study is also limited by its retrospective nature.

Countermeasures for imported COVID-19 cases from Russia through the
Suifenhe port

The successful experiences in controlling domestic transmission of COVID-19 in China can
be used for reference in imported cases from abroad. Controlling imported cases from over-
seas and preventing the second epidemic outbreak have posed new challenges in China [12].
Suifenhe city has established a joint prevention and control mechanism, namely “closed-loop
management, segmented responsibility and seamless docking”, and has strictly carried out
port quarantine measures of “three screenings, three inspections and one trans-shipment” to
avoid the spread of overseas epidemics through the Suifenhe port, which is similar to the con-
trol measures adopted by some other countries [31, 32]. Among them, “three screenings”
include three screening links of health declaration card, temperature monitoring, and medical
patrolling; “three inspections” refer to the rigorous implementation of epidemiological, medi-
cal, and laboratory inspections; “one trans-shipment” means to transfer confirmed cases, sus-
ppected cases, close contacts and individuals with fever and respiratory symptoms to a
designated hospital or a local joint prevention and control isolation program and generate
handover records. “Six hundred percent” management and a control plan are strictly imple-
mented, that is, 100% quarantine for entry vehicles, 100% temperature monitoring for entry
personnel, 100% health declaration card verification, 100% nucleic acid amplification testing,
100% epidemiological investigation, and 100% centralized isolation. All entry personnel are
sent to designated hotels for the isolation program to firmly cut off the source of infection. With the continuous upgrading of epidemic prevention and management measures, a large number of volunteers participate and play an important role.

In accordance with the “four concentrations” principle, that is, concentration of patients, experts, medical resources and treatment, all confirmed cases were subjected to assessment, of whom asymptomatic infection cases, mild and moderate cases, and severe and critical cases were managed in the Suifenhe square cabin hospital, Mudanjiang Ankang hospital, and Hongoi Hospital Affiliated Mudanjiang Medical University, respectively. Eight transfer ambulances with negative pressure functions were deployed to complete the transfer of confirmed imported patients.

Conclusions
To the best of our knowledge, our study presented the description of the latest and most comprehensive data on COVID-19 cases imported from Russia through the Suifenhe port and proposed corresponding countermeasures. Compared with domestic confirmed cases, these imported cases had significantly different clinical features. The results of the present study are practically and clinically significant for management and prevention of another outbreak of COVID-19. Certainly, the development of the epidemic is ever-changing, especially with the mutation of the virus. The prevention, diagnosis and treatment of COVID-19 also need to change to adapt to the development, but some basic principles should be consistent. The world is “a Community of a Shared Future for Mankind”. Therefore, it requires the joint efforts of all countries to overcome the pandemic.

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**References**

1. Leung K, Shum MH, Leung GM, Lam TT, Wu JT. Early transmissibility assessment of the N501Y mutant strains of SARS-CoV-2 in the United Kingdom, October to November 2020. Euro Surveill. 2021; 26(1). Epub 2021/01/09. https://doi.org/10.2807/1560-7917.ES.2020.26.1.2002106 PMID: 33413740; PubMed Central PMCID: PMC7791602.

2. Bwire GM, Paulo LS. Coronavirus disease-2019: is fever an adequate screening for the returning travelers? Trop Med Health. 2020; 48:14. Epub 2020/03/14. https://doi.org/10.1186/s41182-020-00201-2 PMID: 32165854; PubMed Central PMCID: PMC7061485.

3. Huang C, Wang Y, Li X, Ren L, Zhao J, Hu Y, et al. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China: a descriptive study. Lancet. 2020; 395(10223):507–13. Epub 2020/02/03. https://doi.org/10.1016/S0140-6736(20)30211-7 PMID: 32007143; PubMed Central PMCID: PMC7135076.

4. Zhou F, Yu T, Du R, Fan G, Liu Y, Liu Z, et al. Clinical course and risk factors for mortality of adult inpatients with COVID-19 in Wuhan, China: a retrospective cohort study. Lancet. 2020; 395(10223):1054–62. Epub 2020/03/15. https://doi.org/10.1016/S0140-6736(20)30566-3 PMID: 32171076; PubMed Central PMCID: PMC7270627.

5. Zhang J, Wang X, Jia X, Li J, Hu K, Chen G, et al. Risk factors for disease severity, unimprovement, and mortality in COVID-19 patients in Wuhan, China. Clin Microbiol Infect. 2020; 26(6):767–72. Epub 2020/04/19. https://doi.org/10.1093/cmi/cmy028 PMID: 32304745; PubMed Central PMCID: PMC7159868.

6. Wang K, Zuo P, Liu Y, Zhang M, Zhao X, Xie S, et al. Clinical and Laboratory Predictors of In-hospital Mortality in Patients With Coronavirus Disease-2019: A Cohort Study in Wuhan, China. Clin Infect Dis. 2020; 71(16):2079–88. Epub 2020/05/04. https://doi.org/10.1093/cid/ciaa538 PMID: 32361723; PubMed Central PMCID: PMC717616.

7. Wang K, Zuo P, Liu Y, Zhang M, Zhao X, Xie S, et al. Clinical and Laboratory Predictors of In-hospital Mortality in Patients With Coronavirus Disease-2019: A Cohort Study in Wuhan, China. Clin Infect Dis. 2020; 71(16):2079–88. Epub 2020/05/04. https://doi.org/10.1093/cid/ciaa538 PMID: 32361723; PubMed Central PMCID: PMC717616.

8. Sun Q, Qiu H, Huang M, Yang Y. Lower mortality of COVID-19 by early recognition and intervention: experience from Jiangsu Province. Ann Intensive Care. 2020; 10(1):33. Epub 2020/03/20. https://doi.org/10.1186/s13613-020-00650-2 PMID: 32189136; PubMed Central PMCID: PMC7080931.

9. Chen L, Cai J, Lin Q, Xiang B, Ren T. Imported COVID-19 cases pose new challenges for China. J Infect. 2020; 80(6):e43–e4. Epub 2020/04/14. https://doi.org/10.1016/j.jinf.2020.03.048 PMID: 32283157; PubMed Central PMCID: PMC7151481.

10. Yang X, Yu Y, Xu J, Shu H, Ji X, Liu H, et al. Clinical course and outcomes of critically ill patients with SARS-CoV-2 pneumonia in Wuhan, China: a single-centered, retrospective, observational study. Lancet Respir Med. 2020; 8(5):475–81. Epub 2020/05/08. https://doi.org/10.1016/S2213-2600(20)30079-5 PMID: 32105632; PubMed Central PMCID: PMC7102538.

11. Zhu N, Zhang D, Wang W, Li X, Yang B, Song J, et al. A Novel Coronavirus from Patients with Pneumonia in China, 2019. N Engl J Med. 2020; 382(8):727–33. Epub 2020/01/25. https://doi.org/10.1056/NEJMoA2001017 PMID: 31798945; PubMed Central PMCID: PMC7092803.

12. Qiu H, Tong Z, Ma P, Hu M, Peng Z, Wu W, et al. Intensive care during the coronavirus epidemic. Intensive Care Med. 2020; 46(4):576–8. Epub 2020/02/23. https://doi.org/10.1007/s00134-020-05966-y PMID: 32077996; PubMed Central PMCID: PMC7080064.

13. Xia JG, Zhao JP, Cheng ZS, Hu Y, Duan J, Zhan QY. Non-invasive respiratory support for patients with novel coronavirus pneumonia: clinical efficacy and reduction in risk of infection transmission. Chin Med J (Engl). 2020; 133(9):1109–11. Epub 2020/02/26. https://doi.org/10.1097/CM9.0000000000007611 PMID: 32097201; PubMed Central PMCID: PMC7213630.
17. Wu JT, Leung K, Leung GM. Nowcasting and forecasting the potential domestic and international spread of the 2019-nCoV outbreak originating in Wuhan, China: a modelling study. Lancet. 2020; 395(10255):689–97. Epub 2020/02/06. https://doi.org/10.1016/S0140-6736(20)30260-9 PMID: 32014114; PubMed Central PMCID: PMC7159271.

18. Escalera-Anteza JP, Lizón-Ferrufino NF, Maldonado-Alanoa A, Alarcon-De-la-Vega G, Alvarado-Arnez LE, Balderrama-Saavedra MA, et al. Clinical features of the first cases and a cluster of Coronavirus Disease 2019 (COVID-19) in Bolivia imported from Italy and Spain. Travel Med Infect Dis. 2020; 35:101653. Epub 2020/04/06. https://doi.org/10.1016/j.tmaid.2020.101653 PMID: 32247926; PubMed Central PMCID: PMC7129170.

19. Qiu G, Gai Z, Tao Y, Schmitt J, Kullak-Ublick GA, Wang J. Dual-Functional Plasmonic Photothermal Biosensors for Highly Accurate Severe Acute Respiratory Syndrome Coronavirus 2 Detection. ACS Nano. 2020; 14(5):5268–77. Epub 2020/04/14. https://doi.org/10.1021/acsnano.0c02439 PMID: 32281785; PubMed Central PMCID: PMC7158889.

20. Xiao AT, Tong YX, Zhang S. False negative of RT-PCR and prolonged nucleic acid conversion in COVID-19: Rather than recurrence. J Med Virol. 2020; 92(10):1755–6. Epub 2020/04/10. https://doi.org/10.1002/jmv.25855 PMID: 32281785; PubMed Central PMCID: PMC7158889.

21. Li Y, Yao L, Li J, Chen L, Song Y, Cai Z, et al. Stability issues of RT-PCR testing of SARS-CoV-2 for hospitalized patients clinically diagnosed with COVID-19. J Med Virol. 2020; 92(7):903–8. Epub 2020/03/29. https://doi.org/10.1002/jmv.25786 PMID: 32281785; PubMed Central PMCID: PMC72262304.

22. Wu J, Liu J, Zhao X, Liu C, Wang W, Wang D, et al. Clinical Characteristics of Imported Cases of Coronavirus Disease 2019 (COVID-19) in Jiangsu Province: A Multicenter Descriptive Study. Clin Infect Dis. 2020; 71(15):706–12. Epub 2020/02/29. https://doi.org/10.1093/cid/ciaa199 PMID: 32109279; PubMed Central PMCID: PMC7108195.

23. Li Q, Guan X, Wu P, Wang X, Zhou L, Tong Y, et al. Early Transmission Dynamics in Wuhan, China, of Novel Coronavirus-Infected Pneumonia. N Engl J Med. 2020; 382(13):1199–207. Epub 2020/01/30. https://doi.org/10.1056/NEJMoa2001316 PMID: 31995857; PubMed Central PMCID: PMC7121484.

24. Wang W, Zhou D, Jia X, Feng Y. Influenza-like illnesses caused by a cluster of imported Italian COVID-19. J Med Virol. 2020; 92(10):1764–6. Epub 2020/04/14. https://doi.org/10.1002/jmv.25869 PMID: 32281785; PubMed Central PMCID: PMC7121484.

25. Gautier JF, Ravussin Y. A New Symptom of COVID-19: Loss of Taste and Smell. Obesity (Silver Spring). 2020; 28(5):848. Epub 2020/04/03. https://doi.org/10.1002/oby.22809 PMID: 32337199; PubMed Central PMCID: PMC7228286.

26. Spinato G, Fabbris C, Polese J, Cazzador D, Borsetto D, Hopkins C, et al. Alterations in Smell or Taste in Mildly Symptomatic Outpatients With SARS-CoV-2 Infection. JAMA. 2020; 323(20):2089–90. Epub 2020/04/23. https://doi.org/10.1001/jama.2020.6771 PMID: 32320008; PubMed Central PMCID: PMC7177631.

27. Giacomelli A, Pezzati L, Conti F, Bernacchia D, Siano M, Oreni L, et al. Self-reported Olfactory and Taste Disorders in Patients With Severe Acute Respiratory Coronavirus 2 Infection: A Cross-sectional Study. Clin Infect Dis. 2020; 71(15):889–90. Epub 2020/03/28. https://doi.org/10.1093/cid/ciaa330 PMID: 32215618; PubMed Central PMCID: PMC7184514.

28. Moein ST, Hashemian SM, Mansourafshar B, Khorrarn-Tousi A, Tabarsi P, Doty RL. Smell dysfunction: a biomarker for COVID-19. Int Forum Allergy Rhinol. 2020; 10(8):944–50. Epub 2020/04/18. https://doi.org/10.1002/air.22587 PMID: 32301284; PubMed Central PMCID: PMC7262123.

29. Wong SH, Lui RN, Sung JJ. Covid-19 and the digestive system. J Gastroenterol Hepatol. 2020; 35(5):744–8. Epub 2020/03/28. https://doi.org/10.1111/jgh.15047 PMID: 32215956.

30. Hajifathalian K, Mahadev S, Schwartz RE, Shah S, Sambath K, Schnoll-Sussman F, et al. SARS-COV-2 infection (coronavirus disease 2019) for the gastrointestinal consultant. World J Gastroenterol. 2020; 26(14):1546–53. Epub 2020/04/25. https://doi.org/10.3748/wjg.v26.i14.1546 PMID: 32327904; PubMed Central PMCID: PMC7167410.

31. Chiew CJ, Li Z, Lee VJ. Reducing onward spread of COVID-19 from imported cases: quarantine and ‘stay at home’ measures for travellers and returning residents to Singapore. J Travel Med. 2020; 27(3). Epub 2020/04/17. https://doi.org/10.1093/jtm/taaa049 PMID: 32297942; PubMed Central PMCID: PMC7184366.

32. Kim JY, Choe PG, Oh Y, Oh KJ, Kim J, Park SJ, et al. The First Case of 2019 Novel Coronavirus Pneumonia Imported into Korea from Wuhan, China: Implication for Infection Prevention and Control Measures. J Korean Med Sci. 2020; 35(5):e61. Epub 2020/02/08. https://doi.org/10.3346/jkms.2020.35.e61 PMID: 32030925; PubMed Central PMCID: PMC7008073.