A Case of Prolonged Shedding of SARS-Cov-2 with Rapid Decay of IgG Antibody

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Case Report

Keywords: Coronavirus disease 2019, False negative of RT-PCR, Prolonged viral RNA shedding, SARS-Cov-2, Antibodies

Posted Date: January 22nd, 2021

DOI: https://doi.org/10.21203/rs.3.rs-151695/v1

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A case of prolonged shedding of SARS-Cov-2 with rapid decay of IgG antibody

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Abstract

Background

Coronavirus disease 2019 (COVID-19) epidemic is still spreading rapidly around the world.

Recent cases with prolonged detection of SARS-CoV-2 RNA have been successively reported and the phenomenon of false-negative real-time polymerase chain reaction (RT-PCR) results of SARS-CoV-2 RNA or “repositive” was also described in patients with COVID-19.
**Case presentation**

A 69-year-old female with hypertension, total hysterectomy for hysteromyoma and suspected lung tumor presented with moderate COVID-19 symptoms was testing positive for SARS-CoV-2 RNA by RT-PCR when she travelled from USA to China. The patient required second and third re-hospitalization due to repositive SARS-CoV-2 test results of throat swaps during post-charge solitary isolation and observation. The serum SARS-CoV-2-IgG decayed rapidly and disappeared on illness day 139 when the throat swab was still positive for SARS-CoV-2 RNA. Finally the virus shedding lasted at least 146 days (the last positive test result of throat swap on illness day 146 and the first true-negative test result on illness day 151) from her initial positive test.

**Conclusions**

Prolonged viral shedding of SARS-CoV RNA is prone to occur in an immunocompromised host. With the change of host immune status, SARS-CoV-2 detection can be repeatedly positive. The SARS-CoV-2-IgG may decrease rapidly and disappear before the virus removal, indicating there may be certain limitations on the protective effect of antibody against SARS-CoV-2 which deserves attention of clinicians.

**Keywords:** Coronavirus disease 2019, False negative of RT-PCR, Prolonged viral RNA shedding, SARS-Cov-2, Antibodies
Background

Coronavirus disease 2019 (COVID-19) epidemic is still spreading rapidly around the world. As of December 29, 2020, severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection has caused over 79 million cases and over 1.7 million deaths worldwide and the epidemic continues to worsen in most countries (https://www.who.int/emergencies/diseases/novel-coronavirus-2019/situation-reports). As is known to all, testing positive for SARS-CoV-2 RNA is the gold standard for the diagnose of COVID-19 [1] and two consecutive negative for SARS-CoV-2 RNA test results are one of the criteria for discharge. A retrospective study of 301 patients with COVID-19 in China showed that the median duration of viral shedding was 20 days from illness onset, whereas prolong virus replication (>28 days) was found in 25 patients and the longest duration was 42 days [2].

Currently, some similar cases with prolonged detection of SARS-CoV-2 RNA have been successively reported and the shedding duration lasted from 60 to 156 days [3-6]. Additionally, recent reports have also showed false-negative real-time polymerase chain reaction (RT-PCR) results of SARS-CoV-2 nucleic acid or “repositive” phenomenon in patients with COVID-19 [2,7-9]. Herein, we report a case of recovered COVID-19 patient with repeating recurrence of positive SARS-CoV-2 RNA for at least 146 days (the last positive test result on illness day 146 and the first true-negative test result on illness day 151) and the gradual disappearance of IgG against SARS-CoV-2 before the virus removal.

Case description

A 69-year-old Chinese female travelled from New York, USA to Fuzhou Changle
International Airport, China on March 22nd, 2020, and her throat swab specimen was positive for SARS-CoV-2 RNA based on RT-PCR testing on the same day during routine screening. She just felt slight fatigue and loss of appetite without cough, fever, dyspnea or other infectious symptoms. The patient with a history of hypertension and total hysterectomy for hysteromyoma was subsequently admitted to the negative pressure isolation room in Fuzhou Pulmonary Hospital of Fujian Province which was the designated hospital of COVID-19 treatment the next day. The main laboratory examinations throughout the course of the disease after onset are showed in table 1-3 and Fig. 1. Throat swab was tested again based on qualitative RT-PCR assay which was performed using a COVID-19 nucleic acid detection kit (Da An Gene Co., Ltd. of Sun Yat-sen University, China) and the result was definitely positive for SARS-CoV-2 RNA after hospitalization. The results of cardiac-associated enzymes [creatine kinase (CK), creatine kinase isoenzyme (CK-MB) and myohemoglobin (MYO)] and Interleukin-6 (IL-6) showed increased on admission. Leukopenia, thrombocytopenia and lymphopenia with obviously decreased T lymphocyte subgroups including CD3+, CD4+, and CD8+ T cells in peripheral blood were also noted. Arterial blood gas analysis showed a partial pressure of oxygen (PaO₂) of 80.6 mmHg, a partial pressure of carbon dioxide (PaCO₂) of 36.9 mmHg and arterial oxygen saturation (SaO₂) 94.6% in the air. C-reactive protein (CRP), erythrocyte sedimentation rate (ESR) and lactic dehydrogenase (LDH) levels gradually increased during hospitalization. A human immunodeficiency virus (HIV) antibody test was negative and procalcitonin (PCT) kept normal. Chest CT findings showed as follow: (1) multiple patchy ground-glass opacities (GGOs) in both lungs indicating viral pneumonia; (2) a nodular consolidation shadow (1.0 cm × 0.7 cm in size)
with lobulated sign and spiculation in the dorsal lobe of the left lower lung (LLL-S6) indicating suspected isolated lung tumor (Fig. 2A). A bedside echocardiography showed aortic sclerosis, aortic valve thickening, normal left ventricular systolic function, tricuspid regurgitation with mildly elevated pulmonary arterial pressure. Color doppler ultrasonography of the whole abdomen revealed double renal cyst without other abnormalities. Color doppler ultrasonography of the neck suggested the possibility of nodular goiter without lymph node enlargement.

The patient was mainly diagnosed with confirmed moderate COVID-19 according to the diagnostic criteria¹ and suspected early lung tumor with hypoxemia. She received antivirals with abidor and recombinant human interferon α-2b spray and other therapeutic drugs including traditional Chinese medicine, ulinastatin, thymalfasin, human granulocyte colony stimulating factor, amlodipine, etc. She was also administering oxygen inhalation by nasal cannula at 2L/minute. After 2 days of treatment, the patient developed cough and expectoration although fatigue disappeared and appetite improved. On illness day 10 (9 days after initial positive virus test), the patient’s condition became better with the disappearance of symptoms and the improvement of blood indexes (Table 1, 2). Repeated chest CT revealed progress of partial lesions with absorption of partial lesions in both lungs (Fig. 2B). On illness day 13, the detection of serum antibodies against SARS-CoV-2 based on gold immunnochromatography (GICA) which was performed using a COVID-19 antibody detection kit [Inot (Tangshan) Biotechnology Co.,Ltd., China)] was positive for IgG and negative for IgM. On illness day 32, repeated chest CT showed significant absorption of
infected lesions in both lungs (Fig. 2C). The throat swab samples were continuously negative for SARS-CoV-2 RNA on illness days 34 and 37 and the patient was discharged on illness day 38. According to the post-discharge isolation management, the patient was transferred to the fixed isolation point for continuous solitary isolation and observation for 2 weeks.

On illness day 51 (the 14th day of the isolation observation after discharge), the patient’s throat swab was re-detectable positive (RP) for SARS-CoV-2 RNA, although she had no special discomfort. She was transferred to our hospital again for solitary isolation on the same day. Retest of IgG against SARS-CoV-2 was positive and the other laboratory results were normal. Chest CT showed continuously absorption of residual infection lesions in both lungs and the suspected cancerous nodule in the LLL-S was slightly larger than that before (1.2 cm × 0.9 cm in size). The patient was given antiviral drug with recombinant human interferon α-2b spray, immunopotentiator with thymalfasin and hypotensive drugs with amlodipine and benazepril. The throat swab test was still positive for SARS-CoV-2 RNA on illness day 72. On illness days 76 and 80, the throat swabs were continuously negative for SARS-CoV-2 RNA. The detection of IgG against SARS-CoV-2 was reduced to a weak positive and the antibody titer was only 1:10 on illness day 81. The patient kept well and she was discharged again to be continuous solitary isolation and observation at the fixed isolation point for 2 weeks on illness day 81.

The sample of throat swab was rechecked with a negative result of SARS-CoV-2 RNA 14 days after the second discharge. Then the patient went home for continuous solitary isolation and observation. Surprisingly, on illness day 110 (the 16th of home quarantine), the patient’s throat swab was RP for SARS-CoV-2 RNA again and she was transferred to our hospital.
without any symptoms for the third times. Chest CT revealed that a small number of residual infection lesions were similar to those before, and the initial solid nodule in the LLL-S was slightly larger (1.4cm × 1.0 cm in size). The re-detection of SARS-CoV-2- IgG was weakly positive and the antibody titer was reduced to be 1:1 on illness day 110 (Tabel 2). Elevated of CK, CK-MB and LDH levels and reduced T lymphocyte subgroups were noted again (Tabel S1, 2 and Fig. 1). Tumor markers were normal. The serum 1,3-β-D-glucan (G) test, galactomannan (GM) test and cryptococcus capsular antigen test were all negative. The patient was treated with thymalfasin for immuno-enhancement and hypotensive drugs with amlodipine and benazepril. After treatment, LDH, CK, CKMB and ESR all returned to normal. T lymphocyte subgroups initially increased to normal, whereas the indexes declined again after a while. On illness day 121, the titer of SARS-CoV-2- IgG remained 1:1. However, the antibodies of IgG and IgM against SARS-CoV-2 were both negative on illness day 139 (Table S2). An additional GICA test was performed using a kit from a different manufacturer (Guangzhou Wondfo Biotech Co., Ltd., China) and the result was also negative for IgG and IgM. Negative RT-PCR results of SARS-CoV-2 nucleic acid of throat swabs were found on illness days 125 and 129, whereas the samples were RP on illness days 132 and 146. On illness days 151, 153, 157 and 163, the throat swabs were continuously negative for SARS-CoV-2 RNA. The re-detections of IgG and IgM against SARS-CoV-2 remained negative on illness days 149 and 164. Meanwhile, repeated chest CT revealed that a few residual infection lesions were similar to those before, and the initial solid nodule in the LLL-S continuously enlarged (1.5cm × 1.3 cm in size). On illness day 164, the patient was discharged to be continue solitary isolation and observation for the
third times at the fixed isolation point for 2 weeks and subsequent home quarantine for 2
weeks. The latest outpatient follow-up was September 30th, 2020 (the 190th day of illness
onset), the patient remained well without recurrence, except for a slightly reduced T
lymphocyte subgroups (Fig. 1 and Table 2).

Discussion

As seen in this case, the phenomenon of RP for SARS-CoV-2 RNA lasted for about 5
months after the onset of the disease. Although quantitative viral nucleic acid test, isolation
of live virus and viral genome sequencing could not be performed due to the laboratory
limitations in our hospital, the case was considered to be prolonged viral shedding but not a
COVID-9 re-infection for several reasons as follows: First, the patient was quarantined
alone after the first discharge, including the period of isolation and observation outside our
hospital and the two re-hospitalizations, and she did not contact with any new source of
infection. Second, except for the slight increase of LDH, CK, CKMB and ESR within a
short time during the third hospitalization, the important inflammatory markers such as CRP
and IL-6 kept normal after the first hospital discharge. Third, there were no new clinical
symptoms or exacerbation of viral infection on dynamic chest CT after the first hospital
discharge.

Prolong viral shedding in this case was considered to be related to the aging and the
accompanying underlying diseases which might result in immune dysfunction [2,7], and the
insufficient antiviral effect of IgG antibody. First, the solid nodule with lobulated sign and
spiculation in the LLL-S6 gradually increased in size within 5 months while viral
pneumonia had been obviously absorbed, indicating a high probability of tumor. That was
to say, the elderly COVID-19 patient had three underlying diseases with hypertension, total
hysterectomy for hystomyoma and suspected lung tumor. Moreover, the total lymphocyte
count and T lymphocyte subsets count were repeatedly decreased in dynamic monitoring.
All the above factors suggested cellular immune deficiency in this patient which was the
important reason of the difficulty in completely eliminating the virus [7,10]. Second, IgG
against SARS-CoV-2 in this patient was initially tested with positive result by qualitative
detection method on illness day 13, whereas the antibody concentration was only 1:10 based
on semi-quantitative detection method on illness day 81 during the second hospitalization,
indicating IgG antibody titer in vivo was already extremely low at that time. The titer of IgG
antibody continued to decline progressively to 1:1 on illness day 110 during the third
hospitalization, and it was undetectable by two different test methods on illness day 139
when the throat swab was still positive at that time. Although the peak of IgG antibody titer
in our patient was unknown at the beginning of the disease due to absence of quantitative
detection, it was certain that the IgG concentration had been at a very low level about 2.5
months after onset, which was similar to previous reports [11,12]. It was suggested the
ability of the IgG antibodies against SARS-CoV-2 decreased rapidly at the early course of
the disease and nearly disappeared at the middle and later course of the disease in this case.
Therefore, cellular immune deficiency and insufficient humoral immune response in the
older patient as seen in our case resulted in a prolonged virus removal. Additionally, as seen
in this patient, the immune status obviously fluctuated with frequent decrease of lymphocyte
during the whole course of the disease. Reduced immunity could cause repeat increase of
the number of viruses in the body, which appeared as the phenomenon of intermittent virus replication [13]. This may explain alternately positive and negative results of SARS-CoV-2 detection in this patient.

Conclusions

This case suggests prolonged virus shedding is prone to occur in an immunocompromised host [5, 6]. With the change of host immune status, SARS-CoV-2 detection can be repeatedly positive. A recent case report has confirmed that SARS-CoV-2 can persistently survive with repeat replication more than 5 months after initial infection [6], suggesting that prolonged virus shedding could be associated with prolonged infectivity. Therefore, for such patients, it is necessary to increase the frequency of SARS-CoV-2 nucleic acid testing and enhance the post-discharge isolation management and health monitoring [1]. Notably, the titer of IgG antibody in this case decayed rapidly at the early course of disease onset and the antibody completely disappeared less than 5 months after disease onset before the virus removal, indicating that there may be certain limitations on the protective effect of antibody against SARS-CoV-2, especially in immuno-compromised hosts. As is known to all, most of the current vaccine studies take antibody response as the main evaluation index of vaccine efficacy. However, except for a strong anti-SARS-CoV antibody response, inducing a strong virus-specific memory T cell response should be the future direction of vaccine research [14, 15].

Abbreviations
COVID-19: Coronavirus disease 2019; SARS-CoV-2: severe acute respiratory syndrome

coronavirus 2; RT-PCR: real-time polymerase chain reaction; CK: creatine kinase; CK-MB: creatine kinase isoenzyme; (MYO: myohemoglobin; IL-6: Interleukin-6; PaO₂: partial pressure of oxygen; PaCO₂: partial pressure of carbon dioxide; CRP: C-reactive protein; ESR: erythrocyte sedimentation rate; LDH: lactic dehydrogenase; HIV: human immunodeficiency virus; PCT: procalcitonin; GGOs: ground-glass opacities; LLL-S₆: the dorsal lobe of the left lower lung; GICA: gold immnnochromatography; RP: re-detectable positive; G: 1,3-β-D-glucan; GM: galactomannan

Acknowledgements

We thank the patient; the nurses and clinical staff who are providing care for the patient in Fuzhou Pulmonary Hospital of Fujian.

Funding

This study was supported by grants from the Key Clinical Specialty Discipline Construction Program of Fujian, P.R.C. (2018-145) and the Special Project for COVID-19 prevention and Control in Fuzhou of Fujian, P.R.C. in 2020 (2020-XG-20).

Authors’ Contributions

JBH and CQL managed the data generation and data analysis and drafted the manuscript.

MXH helped to carry out laboratorial data collection. XHW conceived of the study and
reviewed all drafts of the manuscript. JBH and CQL contributed equally as senior authors.

All authors read and approved the final manuscript.

Availability of data and materials

No

Ethics approval and consent to participate

The study was approved by the Ethics Committee of Fuzhou Pulmonary Hospital of Fujian (17th Mar, 2020, No. 2020-021-01), and the participant provided written informed consent.

Consent for publication

Yes

Competing interests

The authors declare that they have no competing interests.

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Figure Legends

Fig 1  Dynamics of T-lymphocyte subgroups and total lymphocyte after illness onset. After the treatment of first hospitalization, T-lymphocyte subgroups and total lymphocyte initially increased to normal, whereas the indexes repeatedly declined during the later course of the disease.

Fig 2  Dynamics of Chest CT findings after illness onset. (A) On illness day 2, Chest CT findings showing as follow: (1) multiple patchy ground-glass opacities (GGOs) in both lungs indicating viral pneumonia; (2) a nodular consolidation shadow (1.0 cm × 0.7 cm in size) with lobulated sign and spiculation in the dorsal lobe of the left lower lung (LLL-S\textsuperscript{6}) indicating suspected isolated lung tumor (arrow). (B) On illness day 10, repeated chest CT showing progress of partial lesions with absorption of partial lesions in both lungs and the suspected cancerous nodule in the LLL-S\textsuperscript{6} was similar to that before. (C) On illness day 32, repeated chest CT showing significant absorption of infected lesions in both lungs and the initial solid nodule in the LLL-S\textsuperscript{6} was similar to that before.
<table>
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<th>IL-6, pg/ml</th>
<th>CRP, mg/L</th>
<th>ESR, mm/h</th>
<th>WBC, $10^9$/L</th>
<th>NEU, $10^9$/L</th>
<th>PLT, $10^9$/L</th>
<th>LYM, $10^9$/L</th>
<th>SaO₂, %</th>
<th>LDH, U/L</th>
<th>CK, U/L</th>
<th>CK-MB, ng/ml</th>
<th>TYO, ng/ml</th>
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CK: Creatinine kinase; CK-MB: Creatine kinase isoenzyme; CRP: C-reactive protein; ESR: Erythrocyte sedimentation rate; IL-6: Interleukin-6; LDH: Lactate dehydrogenase; LYM: Lymphocyte; MYO: Myoglobin; N: Absence of test; NEU: Neutrophil; PLT: Platelet; SaO₂: Arterial oxygen saturation; WBC: White blood cell; Reference of IL-6 is 0-7 pg/mL; Reference of CRP is <10 mg/L; Reference of ESR is 0-20 mm/h; Reference of WBC is 3.5-9.5×10⁹/L; Reference of NEU is 1.8-6.3×10⁹/L; Reference of PLT is 125-350×10⁹/L; Reference of LYM is 1.1-3.2×10⁹/L; Reference of SaO₂ is ≥95%; Reference of LDH is 115-220 U/L; Reference of CK is 24-190 U/L; Reference of CK-MB is <3.61 ng/ml; Reference of MYO is 28-72 ng/ml
<table>
<thead>
<tr>
<th>Day of illness</th>
<th>CD3+ T-LYM, /µL</th>
<th>CD4+ T-LYM, /µL</th>
<th>CD8+ T-LYM, /µL</th>
<th>Total LYM, /µL</th>
<th>CD4/CD8</th>
<th>IgM-</th>
<th>IgG-</th>
<th>IgG-SQ</th>
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<tbody>
<tr>
<td>1 (March 22th, 2020)</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
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<td>Disease onset</td>
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<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
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<td>N</td>
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<tr>
<td>2 (March 23th)/First hospitalization</td>
<td>639</td>
<td>302</td>
<td>303</td>
<td>753</td>
<td>1.0</td>
<td>N</td>
<td>N</td>
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</tr>
<tr>
<td>7 (March 27th)</td>
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<td>294</td>
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<td>1034</td>
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<td>N</td>
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<tr>
<td>21 (April 10th)</td>
<td>1239</td>
<td>617</td>
<td>558</td>
<td>1542</td>
<td>1.11</td>
<td>—</td>
<td>+</td>
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</tr>
<tr>
<td>25 (April 14th)</td>
<td>N</td>
<td>N</td>
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<td>N</td>
<td>N</td>
<td>—</td>
<td>+</td>
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</tr>
<tr>
<td>30 (April 22th)/First hospital discharge</td>
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<td>N</td>
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<td>N</td>
<td>N</td>
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<td>N</td>
<td>N</td>
</tr>
<tr>
<td>51 (May 11th)/Second hospitalization</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>—</td>
<td>+</td>
<td>N</td>
</tr>
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<td>655</td>
<td>753</td>
<td>1752</td>
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<td>62 (May 22th)</td>
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<td>N</td>
<td>N</td>
<td>—</td>
<td>+</td>
<td>N</td>
</tr>
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<td>1255</td>
<td>647</td>
<td>582</td>
<td>1506</td>
<td>1.11</td>
<td>—</td>
<td>+</td>
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<tr>
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<td>1274</td>
<td>599</td>
<td>645</td>
<td>1478</td>
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<td>N</td>
</tr>
<tr>
<td>Out-patient follow-up</td>
<td>110 (July 9th)</td>
<td>865</td>
<td>410</td>
<td>441</td>
<td>1193</td>
<td>0.93</td>
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<tr>
<td>121 (July 20th)</td>
<td>1080</td>
<td>509</td>
<td>542</td>
<td>1303</td>
<td>0.94</td>
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<td>+</td>
<td>1:1</td>
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<tr>
<td>139 (August 7th)</td>
<td>1395</td>
<td>680</td>
<td>679</td>
<td>1729</td>
<td>1.0</td>
<td>—</td>
<td>—</td>
<td>N</td>
</tr>
<tr>
<td>149 (August 17th)</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>—</td>
<td>—</td>
<td>N</td>
</tr>
<tr>
<td>164 (September 1th)/Third hospital discharge</td>
<td>1055</td>
<td>475</td>
<td>554</td>
<td>1319</td>
<td>0.86</td>
<td>—</td>
<td>—</td>
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<tr>
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<td>399</td>
<td>485</td>
<td>1154</td>
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<td>N</td>
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<tr>
<td>194 (September 30th)/Last follow-up</td>
<td>912</td>
<td>459</td>
<td>453</td>
<td>1112</td>
<td>1.01</td>
<td>N</td>
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</tbody>
</table>

LYM: Lymphocyte; N: Absence of test; QD: Qualitative detection; SQD: Semi-quantitative detection; +: Positive for IgM or IgG against SARS-CoV-2; —: Negative for IgM or IgG against SARS-CoV-2. Reference of CD3+ T-LYM is 955-2860/µL; Reference of CD4+ T-LYM is 550-1440/µL; Reference of CD8+ T-LYM is 320-1250/µL; Reference of CD4+/CD8+ is 0.64-2.85
# Table 3. Dynamics of RT-PCR test of SARS-CoV-2 RNA

<table>
<thead>
<tr>
<th>Day of illness</th>
<th>Throat swab</th>
<th>Anal swab</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (March 22\textsuperscript{nd}, 2020)/Disease onset</td>
<td>+</td>
<td>N</td>
</tr>
<tr>
<td>2 (March 23\textsuperscript{rd})/First hospitalization</td>
<td>+</td>
<td>N</td>
</tr>
<tr>
<td>9 (March 30\textsuperscript{rd})</td>
<td>+</td>
<td>N</td>
</tr>
<tr>
<td>14 (April 4\textsuperscript{th})</td>
<td>+</td>
<td>N</td>
</tr>
<tr>
<td>18 (April 8\textsuperscript{th})</td>
<td>+</td>
<td>N</td>
</tr>
<tr>
<td>21 (April 11\textsuperscript{st})</td>
<td>+</td>
<td>N</td>
</tr>
<tr>
<td>25 (April 15\textsuperscript{th})</td>
<td>+</td>
<td>N</td>
</tr>
<tr>
<td>34 (April 24\textsuperscript{th})</td>
<td>—</td>
<td>N</td>
</tr>
<tr>
<td>37 (April 27\textsuperscript{th})</td>
<td>—</td>
<td>N</td>
</tr>
<tr>
<td>38 (April 28\textsuperscript{th})/First hospital discharge</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>51 (May 11\textsuperscript{th})/Second hospitalization</td>
<td>+</td>
<td>N</td>
</tr>
<tr>
<td>58 (May 18\textsuperscript{th})</td>
<td>+</td>
<td>N</td>
</tr>
<tr>
<td>64 (May 24\textsuperscript{th})</td>
<td>+</td>
<td>N</td>
</tr>
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<td>69 (May 29\textsuperscript{th})</td>
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<td>N</td>
</tr>
<tr>
<td>72 (June 1\textsuperscript{st})</td>
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<td>—</td>
</tr>
<tr>
<td>76 (June 5\textsuperscript{th})</td>
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</tr>
<tr>
<td>80 (June 9\textsuperscript{th})</td>
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<td>N</td>
</tr>
<tr>
<td>81 (June 10\textsuperscript{th})/Second hospital discharge</td>
<td>—</td>
<td>N</td>
</tr>
<tr>
<td>94 (June 23\textsuperscript{rd})</td>
<td>+</td>
<td>—</td>
</tr>
<tr>
<td>110 (July 9\textsuperscript{th})/Third hospitalization</td>
<td>+</td>
<td>—</td>
</tr>
<tr>
<td>111 (July 10\textsuperscript{th})</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>118 (July 17\textsuperscript{th})</td>
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<td>—</td>
</tr>
<tr>
<td>125 (July 24\textsuperscript{th})</td>
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<td>—</td>
</tr>
<tr>
<td>129 (July 28\textsuperscript{th})</td>
<td>+</td>
<td>N</td>
</tr>
<tr>
<td>132 (July 31\textsuperscript{st})</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>146 (August 14\textsuperscript{th})</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>151 (August 19\textsuperscript{th})</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>153 (August 21\textsuperscript{st})</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>157 (August 25\textsuperscript{th})</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>163 (August 31\textsuperscript{st})</td>
<td>—</td>
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<tr>
<td>164 (September 1\textsuperscript{st})/Third hospital discharge</td>
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</tr>
<tr>
<td>177 (September 14\textsuperscript{th})</td>
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<td>—</td>
</tr>
<tr>
<td>191 (September 28\textsuperscript{th})/Last follow-up</td>
<td>—</td>
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</tr>
</tbody>
</table>

N: Absence of test; +: Positive for SARS-CoV-2 RNA; —: Negative for SARS-CoV-2 RNA
Figure 1

Dynamics of T-lymphocyte subgroups and total lymphocyte after illness onset. After the treatment of first hospitalization, T-lymphocyte subgroups and total lymphocyte initially increased to normal, whereas the indexes repeatedly declined during the later course of the disease.
Dynamics of Chest CT findings after illness onset. (A) On illness day 2, Chest CT findings showing as follow: (1) multiple patchy ground-glass opacities (GGOs) in both lungs indicating viral pneumonia; (2) a nodular consolidation shadow (1.0 cm×0.7 cm in size) with lobulated sign and spiculation in the dorsal lobe of the left lower lung (LLL-S6) indicating suspected isolated lung tumor (arrow). (B) On illness day 10, repeated chest CT showing progress of partial lesions with absorption of partial lesions in both lungs and the suspected cancerous nodule in the LLL-S6 was similar to that before. (C) On illness day 32, repeated chest CT showing significant absorption of infected lesions in both lungs and the initial solid nodule in the LLL-S6 was similar to that before.