

## LETTER TO THE EDITOR

# Detection of antibodies against SARS-CoV-2 in patients with COVID-19

To the Editor,

Testing for SARS-CoV-2 RNA has become the standard for COVID-19 diagnosis.<sup>1,2</sup> However, a number of false negative results have been reported,<sup>2</sup> resulting in a failure to quarantine infected patients. If unchecked, this could cause a major setback in containing viral transmission.<sup>3</sup>

Titers of SARS-CoV-2 antibodies can reflect the progress of viral infection. Around 60 convalescent patients (with an onset

time of 6-7 weeks) in a ward in the Wuhan Tongji Hospital were tested for specific antibodies against SARS-CoV-2. All patients tested positive for the IgG against the virus, while 13 patients tested negative for immunoglobulin M (IgM), with the immunoglobulin G (IgG) titer being greater than the IgM titer (Table 1 and Figure 1). Meanwhile, the IgM and IgG titers in 10 convalescent patients were tested twice (1 week apart); both titers showed a decrease, with the IgG titer being greater than the

**TABLE 1** Serological data from 60 convalescent patients in the Wuhan Tongji Hospital

Patients	Onset	Tested on	IgM titer, AU/mL	IgG titer, AU/mL
1	13/1/2020	9/3/2020	29.26 (+)	231.67 (+)
2	22/1/2020	3/3/2020	33.71 (+)	198.77 (+)
3	15/1/2020	9/3/2020	17.17 (+)	464.69 (+)
4	24/1/2020	9/3/2020	63.54 (+)	178.23 (+)
5	22/1/2020	9/3/2020	15.36 (+)	369.07 (+)
6	12/1/2020	8/3/2020	50.01 (+)	203.07 (+)
7	30/1/2020	9/3/2020	58.26 (+)	203.00 (+)
8	17/1/2020	9/3/2020	41.21 (+)	405.85 (+)
9	5/2/2020	9/3/2020	12.41 (+)	175.03 (+)
10	4/2/2020	10/3/2020	13.47 (+)	31.60 (+)
11	15/1/2020	12/3/2020	20.90 (+)	162.72 (+)
12	10/2/2020	12/3/2020	18.32 (+)	192.90 (+)
13	18/1/2020	9/3/2020	99.85 (+)	220.03 (+)
14	27/1/2020	10/3/2020	21.88 (+)	139.36 (+)
15	17/1/2020	9/3/2020	76.84 (+)	177.61 (+)
16	1/2/2020	9/3/2020	123.06 (+)	161.16 (+)
17	26/1/2020	8/3/2020	16.45 (+)	194.57 (+)
18	27/1/2020	8/3/2020	115.23 (+)	194.80 (+)
19	20/1/2020	9/3/2020	36.49 (+)	96.75 (+)
20	23/1/2020	9/3/2020	27.08 (+)	136.96 (+)
21	18/1/2020	9/3/2020	176.27 (+)	369.4 (+)
22	28/1/2020	9/3/2020	82.71 (+)	177.69 (+)
23	3/2/2020	9/3/2020	65.15 (+)	241.57 (+)

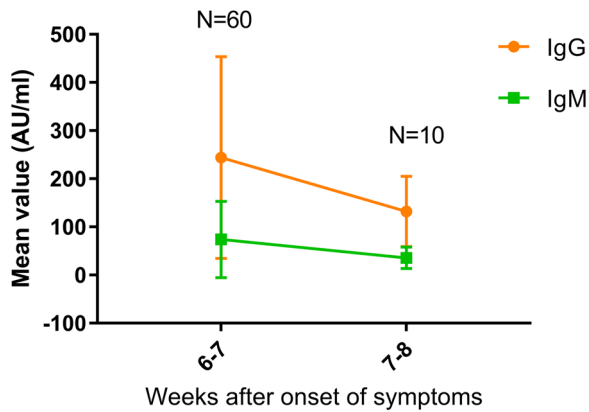
(Continues)

**TABLE 1** (Continued)

Patients	Onset	Tested on	IgM titer, AU/mL	IgG titer, AU/mL
24	24/1/2020	9/3/2020	47.84 (+)	200.31 (+)
25	26/1/2020	8/3/2020	63.52 (+)	165.49 (+)
26	21/1/2020	8/3/2020	164.18 (+)	346.98 (+)
27	20/1/2020	9/3/2020	168.04 (+)	171.85 (+)
28	22/1/2020	8/3/2020	99.28 (+)	137.58 (+)
29	26/1/2020	8/3/2020	66.79 (+)	188.75 (+)
30	3/2/2020	8/3/2020	27.13 (+)	208.82 (+)
31	2/2/2020	6/3/2020	55.03 (+)	186.47 (+)
32	3/2/2020	5/3/2020	164.96 (+)	180.42 (+)
33	27/1/2020	6/3/2020	84.12 (+)	162.14 (+)
34	26/1/2020	9/3/2020	287.54 (+)	299.75 (+)
35	22/1/2020	9/3/2020	346.62 (+)	962.01 (+)
36	28/1/2020	9/3/2020	163.58 (+)	733.95 (+)
37	20/1/2020	8/3/2020	150.93 (+)	158.48 (+)
38	20/1/2020	8/3/2020	114.81 (+)	338.99 (+)
39	27/1/2020	9/3/2020	176.29 (+)	206.03 (+)
40	23/1/2020	9/3/2020	147.93 (+)	965.24 (+)
41	16/1/2020	6/3/2020	45.35 (+)	134.35 (+)
42	20/1/2020	8/3/2020	78.34 (+)	112.56 (+)
43	24/1/2020	6/3/2020	307.14 (+)	420.72 (+)
44	27/1/2020	8/3/2020	181.75 (+)	1077.09 (+)
45	26/1/2020	6/3/2020	41.68 (+)	233.06 (+)
46	26/1/2020	8/3/2020	20.1 (+)	162.79 (+)
47	25/1/2020	6/3/2020	155.64 (+)	279.45 (+)
48	24/1/2020	3/2/2020	8.82 (-)	170.22 (+)
49	1/2/2020	14/3/2020	8.91 (-)	73.35 (+)
50	30/1/2020	8/3/2020	7.33 (-)	185.74 (+)
51	27/1/2020	9/3/2020	2.59 (-)	133.14 (+)
52	30/1/2020	8/3/2020	5.65 (-)	121.43 (+)
53	30/1/2020	9/3/2020	5.53 (-)	20.2 (+)
54	23/1/2020	14/3/2020	9.15 (-)	191.61 (+)
55	12/1/2020	12/3/2020	3.65 (-)	15.16 (+)
56	26/1/2020	10/3/2020	4.12 (-)	25.61 (+)
57	24/1/2020	7/3/2020	3.4 (-)	213.32 (+)
58	20/1/2020	11/3/2020	3.16 (-)	183.32 (+)
59	23/1/2020	4/3/2020	5.01 (-)	208.08 (+)
60	20/1/2020	8/3/2020	6.75 (-)	150.80 (+)

Note: (+) positive result; (-) negative result; titer  $\leq 10$  AU/mL indicates a negative result according to the manufacturer's instructions.

Abbreviations: AU, arbitrary unit; IgG, immunoglobulin G; IgM, immunoglobulin M.



**FIGURE 1** IgM and IgG antibodies level to SARS-CoV-2 from the onset of symptoms. IgG, immunoglobulin G; IgM, immunoglobulin M

IgM titer (Table 2 and Figure 1). In these patients, two consecutive SARS-CoV-2 RNA tests were negative and the chest computed tomography findings indicated improvement. Considering this, their antibody titers and consistent clinical manifestations suggested that antibody detection could act as an indicator of the stage of COVID-19 progression and that the antibodies in convalescent patients are not always maintained at a high level. The immune status fitted both, the clinical and general characteristics of the humoral response. In one report, while 38 patients in the acute phase of the infection tested positive for SARS-CoV-2, 31 (81.6%) of them tested negative for IgM and IgG in serological assays,<sup>4</sup> thereby demonstrating that these patients were in the early stages of infection, as both the antibody titers were relatively low (Supplemental table 1). COVID-19 patients will develop immunity after recovery; however, the persistence, attenuation, and duration of protection of SARS-CoV-2 antibodies requires further investigation.<sup>5</sup>

Presently, data regarding the COVID-19 spectrum are mainly focused on clinical infection with respiratory symptoms. The proportion of subclinical infections and atypical patients remains unknown. Antibody detection will help in the profiling of the COVID-19 spectrum. Epidemiological surveys of serum antibody levels in the population would help in fully understanding how many people have ever been infected. This information will allow the determination of the proportion of different types of infected individuals and a profiling of the complete disease spectrum of COVID-19.

High virus volumes and transmission have been reported in the asymptomatic phase.<sup>6</sup> By combining the results of RNA and antibody testing, we can further identify the contribution of different types of infected people (especially the atypical ones and those with subclinical infection) in the spread of the virus and the disease. This will provide a key scientific basis for the discovery and management of infectious sources.

Detection of IgM and IgG against SARS-CoV-2 is a fast and simple screening method. As an effective supplement to RNA testing, antibody detection is of epidemiological significance and is an

**TABLE 2** Serological data from 10 convalescent patients who were tested twice (1 week apart)

Patients	Onset	1st Test	2nd Test	IgM titer (1st test), AU/mL	IgM titer (2nd test), AU/mL	IgG titer (1st test), AU/mL	IgG titer (2nd test), AU/mL
38	20/1/2020	8/3/2020	15/3/2020	114.81 (+)	36.14 (+)	338.99 (+)	210.33 (+)
39	27/1/2020	9/3/2020	16/3/2020	176.29 (+)	50.21 (+)	206.03 (+)	88.74 (+)
40	23/1/2020	9/3/2020	16/3/2020	147.93 (+)	40.35 (+)	965.24 (+)	201.34 (+)
41	16/1/2020	6/3/2020	13/3/2020	45.35 (+)	13.54 (+)	134.35 (+)	50.33 (+)
42	20/1/2020	8/3/2020	15/3/2020	78.34 (+)	21.36 (+)	112.56 (+)	47.21 (+)
43	24/1/2020	6/3/2020	14/3/2020	307.14 (+)	80.79 (+)	420.72 (+)	97.06 (+)
44	27/1/2020	8/3/2020	15/3/2020	181.75 (+)	47.03 (+)	1077.09 (+)	242.25 (+)
45	26/1/2020	6/3/2020	15/3/2020	41.68 (+)	12.36 (+)	233.06 (+)	95.15 (+)
46	26/1/2020	8/3/2020	15/3/2020	20.1 (+)	9.28 (-)	162.79 (+)	88.68 (+)
47	25/1/2020	6/3/2020	12/3/2020	155.64 (+)	48.49 (+)	279.45 (+)	200.58 (+)

Note: (+) positive result; (-) negative result; titer  $\leq 10$  AU/mL indicates a negative result according to the manufacturer's instructions. Abbreviations: AU, arbitrary unit; IgG, immunoglobulin G; IgM, immunoglobulin M.

important means to understand the occurrence, development, prognosis, and outcome of COVID-19. More medical research on the expression levels of antibodies against SARS-CoV-2 and on the prognosis of COVID-19 is required.

#### ACKNOWLEDGMENTS

This work was supported by the Beijing Natural Science Foundation (7204321). We thank Dr. Bo Yang for collecting and providing serological data.

#### CONFLICT OF INTERESTS

The authors declare that there are no conflict of interests.

#### AUTHOR CONTRIBUTIONS


ZD and FZG drafted the manuscript. FXZ, BY, and TBW cared for the patients and collected the data.

Zhe Du<sup>1</sup>

Fengxue Zhu<sup>1</sup>

Fuzheng Guo<sup>1</sup>

Bo Yang<sup>2</sup>

Tianbing Wang<sup>1</sup> 

<sup>1</sup>Trauma Center, Peking University People's Hospital, Beijing, China

<sup>2</sup>Tongji Medical College, Tongji Hospital, Institute of Organ Transplantation, Huazhong University of Science and Technology, Wuhan, China

#### Correspondence

Tianbing Wang, Trauma Center, Peking University People's Hospital, Beijing 100044, China.

Email: [drtbw01@126.com](mailto:drtbw01@126.com)

#### Funding Information

Beijing Natural Science Foundation, Grant/Award Number: 7204321

Zhe Du and Fengxue Zhu contributed equally to this work.

#### ORCID

Tianbing Wang  <http://orcid.org/0000-0002-5279-9737>

#### REFERENCES

1. The Chinese novel coronavirus pneumonia diagnosis and treatment plan (trial version seven). <http://www.nhc.gov.cn/yzygj/s7653p/202003/46c9294a7dfe4cef80dc7f5912eb1989.shtml>. (Accessed March 20, 2020).
2. Li Z, Yi Y, Luo X, et al. Development and clinical application of a rapid IgM-IgG combined antibody test for SARS-CoV-2 infection diagnosis. *J Med Virol*. 2020. <https://doi.org/10.1002/jmv.25727>. [published online ahead of print February 27, 2020].
3. Guo L, Ren L, Yang S, et al. Profiling early humoral response to diagnose novel coronavirus disease (COVID-19). *Clin Infect Dis*. 2020. <https://doi.org/10.1093/cid/ciaa310>. [published online ahead of print March 21, 2020].
4. Cassaniti I, Novazzi F, Giardina F, et al. Performance of VivaDiag™ COVID-19 IgM/IgG rapid test is inadequate for diagnosis of COVID-19 in acute patients referring to emergency room department. *J Med Virol*. 2020. <https://doi.org/10.1002/jmv.25800>. [published online ahead of print March 30, 2020].
5. Bao L, Deng W, Gao H, et al. Reinfection could not occur in SARS-CoV-2 infected rhesus macaques. *BioRxiv*. 2020. <https://doi.org/10.1101/2020.03.13.990226>
6. Zou L, Ruan F, Huang M, et al. SARS-CoV-2 viral load in upper respiratory specimens of infected patients. *N Engl J Med*. 2020;382(12):1177-1179.

#### SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section.