Highlighted Prospects of an IgM/IgG Antibodies Test in Identifying Individuals With Asymptomatic Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) Infection

Yaqing Li, MD; Qiang He, MD; Rizhen Yu, MD; Hui Jiang, MD; Weizhong Wang, MMed; Dujin Feng, MBBS; Guanghua Hou, MBBS; Hongbin Zhou, MD; Yaona Jiang, MMed; Zhun Xiang, MD

• ***Context.***—**Covert severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infections could be seeding new outbreaks. How to identify asymptomatic SARS-CoV-2 infections early has become a global focus.**

Objective.—**To explore the roles of immunoglobulin M (IgM) and immunoglobulin G (IgG) antibodies detection, nucleic acid tests, and computed tomography (CT) scanning to identify asymptomatic SARS-CoV-2 infection.**

Design.—**The clinical data of 389 individuals with close contacts, including in general characteristics, SARS-CoV-2 etiology, serum-specific IgM and IgG antibody detection and CT imaging results, were systematically analyzed.**

Results.—**The present study showed that only 89 of 389 individuals with close contacts were positive after the first nucleic acid test, while 300 individuals were still negative after 2 nucleic acid tests. Among the 300 individuals, 75 did not have pneumonia, and the other 225 individuals had pulmonary imaging changes. A total of 143 individuals were eventually diagnosed as having asymptomatic infection through IgM antibody and IgG antibody detection. The sensitivity, specificity, and false-negative rate of IgM and IgG antibody detection were approximately 97.1% (347 of 357), 95.3% (204 of 214), and 4.67% (10 of 214), respectively. It also indicated that during approximately 2 weeks, most individuals were both IgM positive and IgG positive, accounting for 68.57% (72 of 105). During approximately 3 weeks, the proportion of IgM-positive and IgG-positive individuals decreased to 8.57% (9 of 105), and the proportion of IgM-negative and IgG-positive individuals increased to 76.19% (80 of 105).**

Conclusions.—**There are highlighted prospects of IgM/IgG antibody detection as a preferred method in identifying the individuals with asymptomatic SARS-CoV-2 infection, especially combined with nucleic acid tests and pulmonary CT scanning.**

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Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), the cause of the coronavirus disease 2019 (COVID-19) pandemic, is spreading throughout the world.[1] More than 1 699 000 confirmed cases and 106 000 deaths have been reported in at least 200 countries as of April 12, 2020. There is still no specific antiviral drug or vaccine against SARS-CoV-2.[1] How to cut off the transmission chain quickly is the key to controlling the COVID-19 epidemic. It was reported that asymptomatic or mild cases combined represented approximately 40% to 50% of all infections, and covert coronavirus infections could also be seeding new outbreaks.[2,3] Therefore, how to identify and manage asymptomatic SARS-CoV-2 infections early has become a global focus. An individual with asymptomatic SARS-CoV-2 infection (asymptomatic infection) is a person who has no clinical manifestations (such as fever, cough, sore throat, or other self-perceptible or clinically identifiable symptoms and signs) but whose respiratory tract or other specimens have tested positive for SARS-CoV-2.[4] A person whose specimens are positive for SARS-CoV-2 nucleic acid in the incubation period should be observed for subsequent illness to determine whether they are truly asymptomatic. Asymptomatic infections are rarely identified as a result of

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From the Department of Internal Medicine, Zhejiang Cancer Hospital, Cancer Hospital of the University of Chinese Academy of Sciences, Hangzhou, Zhejiang, China (Li); the Department of Respiratory Medicine, Zhejiang Provincial People's Hospital, People's Hospital of Hangzhou Medical College, Hangzhou, Zhejiang, China (Li, H. Jiang, Zhou, Y. Jiang); the Department of Nephrology (He, Yu), Center of Laboratory Medicine (Wang, Feng), at Zhejiang Provincial People's Hospital, People's Hospital of Hangzhou Medical College, Hangzhou, Zhejiang, China; the Department of Infection Medicine, Huangpi People's Hospital of Jianghan University, Wuhan, Hubei, China (Hou); and the Division of Information Management and Medical Institute Operation Management, National Center for Medical Service Administration, Beijing, China (Xiang).

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Corresponding author: Zhun Xiang, MD, Division of Information Management and Medical Institute Operation Management, National Center for Medical Service Administration, No. 38 Beilishi Rd, Beijing 100810, China (email: xzhun2020@126.com).

active visits but are detected mainly through close-contact screening, pooled epidemic surveys, and source tracking.

Nucleic acid tests are the gold standard for the diagnosis of SARS-CoV-2 infection.[1,5] They are essential for early detection, early reporting, early isolation, and early treatment. However, the results of nucleic acid tests may be affected by many factors, such as sampling process quality control, nucleic acid kit quality, and laboratory operation ability.[5,6] Pulmonary computed tomography (CT) scanning is indispensable in the course of the management of COVID-19.[7,8] It has been reported that the typical imaging features of COVID-19 are multiple patchy ground-glass opacities, some with consolidation.[7,8] Lesions often involve both lungs or multiple parts of a single lung, are often in both the lower and upper lungs, and are often subpleural, similar to those of Middle Eastern respiratory syndrome. Thus, the imaging evidence should not be ignored in areas with severe COVID-19 outbreaks, even if the patient has no typical clinical symptoms or no symptoms and their nucleic acid tests were negative. However, the typical pulmonary imaging changes in patients with asymptomatic infections are unclear. Immunoglobulin M (IgM) is mainly produced in the primary immune response to infectious agents or antigens. Immunoglobulin G (IgG) is synthesized mostly in the secondary immune response to pathogens. SARS-specific IgG antibody was shown to be generated in the second week and to persist for a long time, whereas IgM was expressed transiently.[9] The changes in serum-specific IgM and IgG antibodies in patients with COVID-19 require further study.

Therefore, how to identify early asymptomatic infections and improve their clinical management still needs further exploration. Therefore, the clinical data of 389 individuals with close contacts, such as general characteristics, SARS-CoV-2 etiology, serum-specific IgM and IgG antibody detection, and pulmonary CT imaging results, were systematically analyzed in the present study.

METHODS

Subjects

This study was a retrospective analysis of the clinical data of 389 individuals with close contacts in Huangpi People's Hospital of Jianghan University (Wuhan, Hubei, China) from February 10, 2020 to March 22, 2020. The diagnostic criteria of asymptomatic infections and mild or common cases of COVID-19 were defined based on the New Coronavirus Pneumonia Prevention and Control Program (trial 7th edition) published by the National Health Commission of China.[10,11] Patients who had severe or critical cases of COVID-19 were excluded from the analysis.[10,11] The Ethics Committee of Huangpi People's Hospital of Jianghan University and Zhejiang Provincial People's Hospital (Hangzhou, Zhejiang, China) approved this study.

Real-Time Reverse Transcriptase Polymerase Chain Reaction

All subjects were initially tested by reverse-transcriptase polymerase chain reaction (RT-PCR) analysis of oropharyngeal swab specimens. The specimens were collected over the whole clinical course. The SARS-CoV-2 *N* gene (*nCon-Np*) and open reading frame 1ab (*nConORF1ab*) were selected as amplification target regions. The specific primers and fluorescent probes were designed (*N* gene probes were labeled with FAM, and ORF1ab probes were labeled with yellow fluorescent protein) and used according to the manufacturer's instructions (Daan Gene Co., Ltd., Guangzhou, China). Laboratory diagnosis was performed according to the World Health Organization guidelines for SARS-CoV-2 laboratory tests.[1]

Antibody Responses Against SARS-CoV-2 Infection

The serum samples were collected on days 12 and 22 from the onset of the isolation of the individuals. Serum IgM and IgG antibodies against SARS-CoV-2 were analyzed using a gold immunochromatography assay. The operation was completed according to the manufacturer's instructions (Innovita Biological Technology Co., Ltd, Tangshan, China).

Statistical Analyses

Statistical analyses were performed using SPSS 17.0 software (SPSS Inc., Chicago, Illinois). Data are expressed as the mean ± standard deviation. The significance of differences between groups was determined by means of a one-way analysis of variance. Multiple comparisons in analysis of variance were performed using the Student-Newman-Keuls test. Differences in proportions were analyzed using χ^2 or Fisher's exact and Mann-Whitney *U* tests. $P < .05$ was considered statistically significant.

RESULTS

Clinical Characteristics of 389 Individuals With COVID-19 Close Contacts

According to the results of the first nucleic acid test for SARS-CoV-2, the 389 individuals with COVID-19 close contacts were divided into 2 groups, 89 individuals who were nucleic acid test positive and 300 individuals who were nucleic acid test negative; individuals in the groups were 45.1 ± 10.2- and 46.3 ± 10.3-years old, respectively, with no significant difference in age ($P = .81$). Among these individuals, 16 had mild clinical symptoms, including 1 case of fever (37.5°C for 1 day), 4 cases of cough, 2 cases of fatigue, 1 case of sore throat, 1 case of chest tightness, and 1 case of diarrhea in the nucleic acid test–positive group. There were 3 cases of chest tightness, 2 cases of cough, and 1 case of fatigue in the nucleic acid test–negative group. As shown in Table 1, cardiovascular diseases and diabetes were the main complications in the 2 groups. There was no significant difference in C-reactive protein (CRP) level ($P = .52$), white blood cell count ($P = .16$), or platelet count ($P = .17$) between the 2 groups (Table 1). There were significant differences in lymphocyte count ($P < .001$) and alanine aminotransferase (ALT; $P < .001$) and aspartate aminotransferase (AST; $P < .001$) levels between the 2 groups. There were 44 individuals in the nucleic acid test–positive group and 75 individuals in the nucleic acid test–negative group in whom no pneumonia was found using CT scanning ($\chi^2 = 19.306$, $P < .001$). The typical imaging changes were shown as limited or several ground-glass opacities or quasiorganic inflammation and fibrous shadows in both groups (Table 1).

Changes in IgM and IgG Antibodies in Individuals With SARS-CoV-2 Infection

The 300 individuals who were nucleic acid test–negative twice for SARS-CoV-2 were divided into 2 groups, with and without pneumonia, according to pulmonary CT imaging results. There were 225 individuals in the group with pneumonia and 75 individuals in the group without pneumonia, who were 47.9 ± 0.7- and 41.4 ± 1.2-years old, respectively, with a significant difference ($F = 23.8$, $P < .001$). There were no significant differences in CRP level ($P = .06$), white blood cell count ($P = .94$), lymphocyte count ($P = .08$), platelet count ($P = .99$), or ALT ($P = .92$), and AST

Table 1. Clinical Characteristics of 389 Individuals With COVID-19 Close Contacts

Characteristics	First 2 SARS-CoV-2 Nucleic Acid Tests		*P* Value
	Positive	Negative	
Males:females, n	49:40	115:185	
Age, yr	45.1 ± 10.2	46.3 ± 10.3	
Fever, n	1 (37.5°C for 1 d)	0	
Cough, n	4	2	
Chest tightness, n	1	3	
Sore throat, n	1	0	
Fatigue, n	2	1	
Diarrhea, n	1	0	
Hypertension, n	5	36	
Coronary heart disease, n	1	11	
Arrythmia, n	1	0	
Diabetes, n	3	17	
Chronic obstructive pulmonary disease, n	1	1	
Asthma, n	0	1	
Bronchiectasis, n	0	2	
Gastritis, n	1	2	
C-reactive protein, mg/dL	14.6 ± 3.12	12.7 ± 1.33	$F = 0.414$ $P = .52$
Routine blood parameters			
White blood cells, μL	6.32 ± 0.17	6.06 ± 0.087	$F = 2.018$ $P = .16$
Lymphocyte, μL	1.78 ± 0.05	2.058 ± 0.035	$F = 13.483$ $P < .001$
Platelets, $\times 10^3/\mu L$	237.5 ± 7.3	220.7 ± 3.16	$F = 5.715$ $P = .17$
Alanine aminotransferase, U/L	20.8 ± 1.43	34.1 ± 1.93	$F = 13.427$ $P < .001$
Aspartate aminotransferase, U/L	26.2 ± 0.98	37.3 ± 1.67	$F = 12.65$ $P < .001$
CT scanning, n			
Without pneumonia	44	75	$X^2 = 19.306$ $P < .001$
With pneumonia (ground-glass opacities, etc)	45	225	

Abbreviation: CT, computed tomography.

Table 2. Characteristics of the 300 Individuals With 2 Negative Nucleic Acid Tests

Characteristics	Computed Tomography Scanning		*P* Value
	With Pneumonia	Without Pneumonia	
Males:females, n	225 (44:181)	75 (22:53)	
Age, yr	47.9 ± 0.65	41.4 ± 1.2	$F = 23.8$ $P < .001$
C-reactive protein, mg/dL	16.9 ± 2.4	12.0 ± 3.5	$F = 1.164$ $P = .28$
Routine blood parameters			
White blood cells, μL	6.06 ± 0.103	6.05 ± 0.158	$F = 0.005$ $P = .94$
Lymphocyte, μL	2.02 ± 0.039	2.16 ± 0.072	$F = 3.127$ $P = .08$
Platelets, $\times 10^3/\mu L$	220.76 ± 3.62	220.63 ± 6.54	$F < .001$ $P = .98$
Alanine aminotransferase, U/L	34.2 ± 2.11	33.68 ± 4.42	$F = 0.011$ $P = .92$
Aspartate aminotransferase, U/L	37.8 ± 1.67	35.4 ± 2.89	$F = 0.388$ $P = .53$

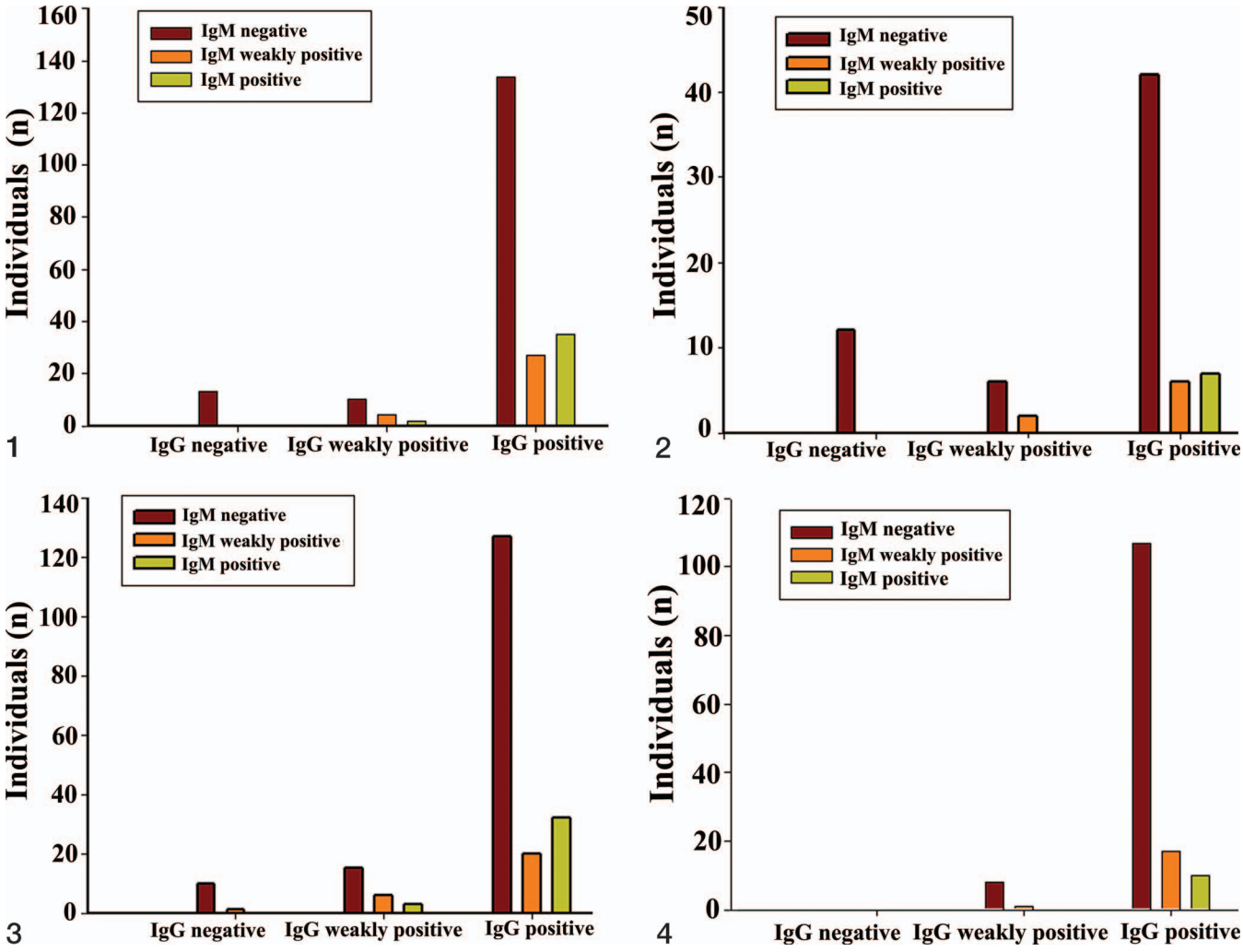

Figure 1. *Determination of IgM and IgG antibodies in the 225 individuals with pneumonia in whom 2 nucleic acid tests were negative. Thirteen (13 of 225; 58%) individuals who were reported as nucleic acid test negative twice, in whom IgM/IgG antibodies were negative. Four individuals were positive in the fourth nucleic acid test. Nine individuals were finally confirmed as uninfected in the following nucleic acid tests.*

Figure 2. *The analysis of IgM and IgG antibodies in the 75 individuals without pneumonia in whom 2 nucleic acid tests were negative. Twelve (12 of 75; 16%) individuals who were reported as nucleic acid test negative twice, in whom IgM/IgG antibodies were negative. Three individuals were positive in the third nucleic acid test. Nine individuals were confirmed as uninfected in the following nucleic acid tests.*

Figure 3. *Changes of IgM and IgG antibodies in 214 asymptomatic individuals who were confirmed by nucleic acid test. Two hundred fourteen asymptomatic individuals were confirmed by nucleic acid test. Ten (10 of 214; 47%) individuals were negative for IgM/IgG antibodies, 4 individuals were positive in the first nucleic acid detection and 6 individuals were positive in the subsequent nucleic acid detection.*

Figure 4. *Definitive diagnosis of 143 asymptomatic individuals in whom 2 nucleic acid tests were negative confirmed using IgM and IgG antibodies detection. One hundred forty-three asymptomatic SARS-CoV-2 individuals who were nucleic acid test negative were confirmed using IgM and IgG antibodies detection.*

($P = .53$) levels between the 2 groups (Table 2). The striking changes in serum IgM and IgG antibodies in both groups are shown in Figure 1. A total of 212 individuals in the group with pneumonia who were SARS-CoV-2 nucleic acid–negative twice were quickly identified as having SARS-CoV-2 infection using IgM and IgG antibody detection (Figure 1). There were 13 other individuals with pneumonia who were reported as nucleic acid test–negative twice, in whom both IgM antibody and IgG antibody were negative (Figure 1). Finally, 4 individuals were positive in the fourth SARS-CoV-2 nucleic acid test, and 9 individuals who were still negative in the following nucleic acid tests were finally confirmed as uninfected (Figure 1). Thus, the sensitivity, specificity, and false-positive rate of CT scanning in the diagnosis of SARS-CoV-2 infection were 75% (225 of 300), 72% (216 of 300), and 3% (9 of 300), respectively (Table 2). Notably, 63 individuals who were SARS-CoV-2 nucleic acid–negative twice and had no pneumonia in pulmonary CT scanning were confirmed having SARS-CoV-2 infection according to the analysis of IgM and IgG antibody detection (Figure 2). Thus, IgM antibody and IgG antibody detection provided strong evidence for the diagnosis of SARS-CoV-2 infection. Another 12 individuals without pneumonia, who were nucleic acid test–negative twice, were negative in the detection of IgM antibody and IgG antibody. Three

Table 3. Clinical Characteristics of 357 Asymptomatic SARS-CoV-2 Infections				
	First Nucleic Acid Test	IgM or IgG Antibody		
Characteristics	Positive		Normal	*P* Value
Males:females, n	103:111	50:93	9:7	
Age, yr	45.9 ± 0.7	45.5 ± 0.8	48.7 ± 3.4	$F = 0.693$ $P = .50$
C-reactive protein, mg/dL	12.2 ± 1.4	12.6 ± 2.3	14.8 ± 5.1	$F = 0.909$ $P = .91$
Routine blood parameters				
White blood cells, μL	6.13 ± 0.1	6.10 ± 0.13	6.00 ± 0.33	$F = 0.056$ $P = .94$
Lymphocyte, μL	1.98 ± 0.039	2.02 ± 0.049	2.24 ± 0.154	$F = 1.565$ $P = .21$
Platelets, $\times 10^3$/μL	229.2 ± 3.94	221 ± 4.90	207 ± 15.7	$F = 1.643$ $P = .20$
Alanine aminotransferase, U/L	29.6 ± 2.05	34.2 ± 2.83	29.3 ± 4.2	$F = 0.977$ $P = .38$
Aspartate aminotransferase, U/L	33.4 ± 1.58	37.9 ± 2.7	32.8 ± 3.8	$F = 1.25$ $P = .29$
CT scanning, n				
Without pneumonia	75	35	7	
With pneumonia (ground-glass opacities, etc)	139	108	9	

Abbreviation: CT, computed tomography.

individuals among them were positive in the third nucleic acid test, and 9 individuals were finally confirmed as uninfected in the following nucleic acid tests (Figure 2).

Highlighted Prospects of IgM and IgG Antibody Detection as a Preferred Method for the Diagnosis of Asymptomatic SARS-CoV-2 Infection

Sixteen individuals were excluded because they had clinical symptoms, in which 2 individuals were uninfected. Another 16 individuals without any symptoms were uninfected. Then, 357 individuals were divided into the following 2 groups: the nucleic acid test–positive group and the antibody-positive group. There were 214 individuals in the nucleic acid test–positive group and 143 individuals in the antibody-positive group who were nucleic acid test–negative. There were no significant differences in age ($P = .50$), CRP level ($P = .91$), white blood cell count ($P = .95$), lymphocyte count ($P = .21$), platelet count ($P = .20$), or ALT ($P = .38$) and AST ($P = .29$) levels among the normal group, the nucleic acid test–positive group, and the antibody-positive group (Table 3). There were 75 individuals with normal pulmonary imaging and limited ground-glass opacities, followed by 91 individuals with several ground-glass opacities and 48 individuals with quasiorganic inflammation, fibrous shadows, and so on. In the antibody-positive group, there were 35 individuals with normal pulmonary imaging and serum antibody positivity and 88 individuals with limited ground-glass opacities. In the normal group, only 7 individuals (7 of 16; 44%) had normal lung imaging, and 3 had limited ground-glass opacities. Therefore, it was not enough to diagnose asymptomatic infection using only nucleic acid tests or lung CT scanning. The changes in IgM and IgG antibodies are also shown in Figures 3 and 4. In the nucleic acid test–positive group, 10 individuals were negative for IgM and negative for IgG, 4 individuals were positive in the first nucleic acid detection, and 6 individuals were positive in the subsequent nucleic acid detection (Figures 3 and 4). The proportions of IgM-negative and IgG-positive individuals were 59.3% (127 of 214) in the nucleic acid test–positive group and 74.8% (107 of 143) in the antibody-positive group. The sensitivity, specificity, and false-negative rate of the detection of IgM and IgG antibodies for the diagnosis of asymptomatic SARS-CoV-2 infection were 97.1% (347 of 357), 95.3% (204 of 214), and 4.67% (10 of 214), respectively, which indicated that IgM and IgG can be recommended as a preferred method to diagnose asymptomatic SARS-CoV-2 infection.

Dynamic Changes in Serum IgM and IgG Antibodies in Asymptomatic SARS-CoV-2 Infection

The serum IgM and IgG antibodies against SARS-CoV-2 were detected twice, on the 12th day and on the 22nd day. The dynamic changes in serum IgM and IgG antibodies in individuals with asymptomatic SARS-CoV-2 infection are shown in Figure 5. There were 6 individuals who were IgM positive and IgG weak positive (6 of 105, 5.71%), 72 individuals who were IgM positive and IgG positive (72 of 105, 68.57%), and 11 individuals who were IgM negative and IgG positive (11 of 105, 10.48%) (Figure 5, A). On the 22nd day, there was 1 individual who was IgM negative and IgG negative, 1 individual who was IgM positive and IgG negative, 12 individuals who were IgM weakly positive and IgG positive (12 of 105, 11.43%), 9 individuals who were IgM positive and IgG positive (9 of 105, 8.57%), 3 individuals who were IgM negative and IgG weakly positive (3 of 105, 2.86%), and 80 individuals who were IgM negative and IgG positive (80 of 105, 76.19%) (Figure 5, B). The proportion of IgM-positive and IgG-positive individuals was reduced from 68.57% to 8.57%, while the proportion of IgM-negative and IgG-positive individuals was increased from 10.48% to 76.19%.

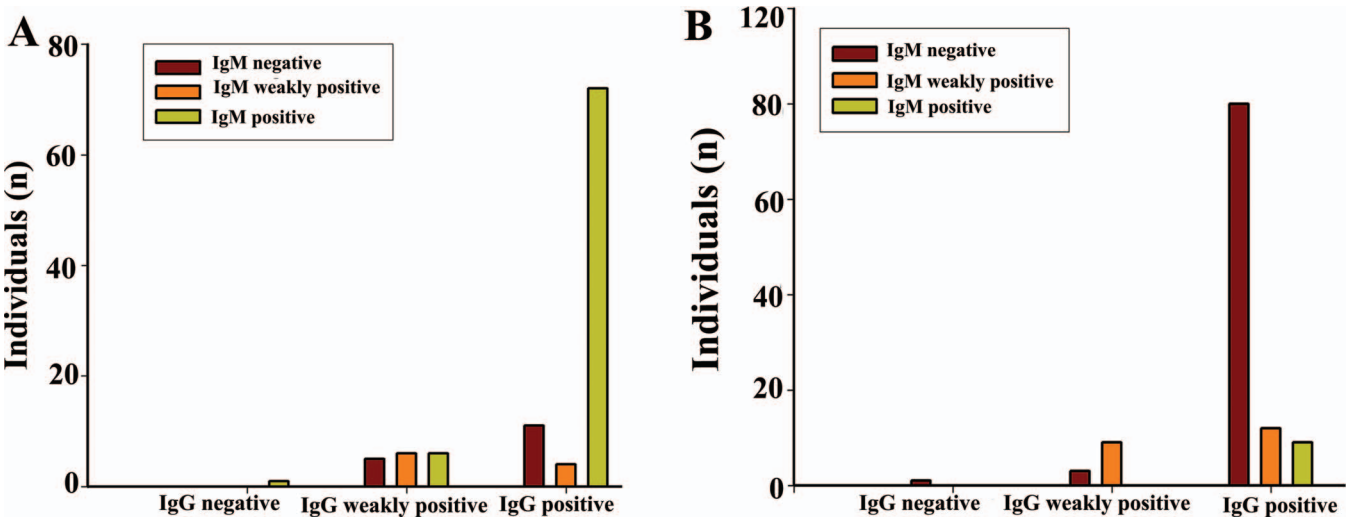

Figure 5. *Changes in IgM and IgG antibodies in the 105 asymptomatic individuals, respectively, on the 12th day and the 22nd day. A, Changes in IgM and IgG antibodies on the 12th day; B, Changes in IgM and IgG antibodies on the 22nd day.*

DISCUSSION

Asymptomatic infection is contagious, which may pose a risk of the start of a new COVID-19 outbreak.[1,4] Early diagnosis of asymptomatic SARS-CoV-2 infection has become a new focus. Nucleic acid detection is a rapid method for the diagnosis of SARS-CoV-2 infection.[6,12] Samples are usually taken from the nasopharynx or oropharynx, but the positive rate is only approximately 30% to 50%.[6,12] The present study indicated that only 89 of the 389 individuals with close contacts were positive after the first nucleic acid test, while 300 were still negative following 2 nucleic acid tests. The positive rate was only 22.9%. The false-negative detection of SARS-CoV-2 may be related to sampling process quality control, nucleic acid kit quality, laboratory operation ability and methods (such as nucleic acid extraction quality control), and so on.[5,6,12] Multiple or multisite nucleic acid tests can improve the positive rate of diagnosis. When the frequency of nucleic acid detection was increased, the positive rate of nucleic acid tests eventually increased from 22.9% (89 individuals) to 61.5% (228 individuals). Eighteen individuals (2 individuals had clinical symptoms) were confirmed to not have SARS-CoV-2 infection.

The typical pulmonary imaging features of COVID-19 are multiple patchy ground-glass opacities or surrounding lesions, such as organizing pneumonia.[7,8] However, it was not clear what the typical pulmonary imaging changes of asymptomatic infection were. Among the 300 individuals who were negative in 2 nucleic acid tests, 75 individuals had no pneumonia, and the other 225 individuals had pulmonary imaging changes, most of which were limited ground-glass opacities or several ground-glass opacities, which were milder than those of individuals with COVID-19. Therefore, the CT diagnostic sensitivity was 75%. There were no significant differences in CRP level, white blood cell count, lymphocyte count, platelet count, or ALT and AST levels between the group without pneumonia and the group with pneumonia. A total of 212 individuals were confirmed as having asymptomatic SARS-CoV-2 infection by the detection of serum IgM antibody and IgG antibody. Four individuals were positive in the fourth nucleic acid test, and 9 individuals were confirmed as being uninfected. Thus, the specificity and false-positive rate of CT diagnosis were approximately 72% and 3%, respectively. On the other hand, 63 individuals in the group without pneumonia were confirmed as having SARS-CoV-2 infection by the detection of serum IgM and IgG antibodies. The other 3 individuals were confirmed to have asymptomatic infection in the third nucleic acid test, and 9 individuals were finally confirmed as being uninfected. Therefore, the sensitivity of CT scanning is high in the diagnosis of COVID-19, and it can be improved using nucleic acid tests and the detection of IgM and IgG antibodies. And it was indicated that IgM antibody and IgG antibody detection have outstanding value for the diagnosis of SARS-CoV-2 infection, and this method should be popularized and applied.

Asymptomatic infections, including those in the middle or late incubation period,[13,14] are contagious, which may lead to a significant increase in family cluster infections.[13] How to identify asymptomatic infected persons early is especially important to prevent them from causing family cluster infections. In the present study, 16 of 389 (42%) individuals had symptoms (2 of whom were uninfected), while the other 16 with no symptoms were not infected with SARS-CoV-2. Of 357 asymptomatic infected individuals, only 10 individuals were negative for IgM and IgG antibodies, of whom 4 were positive in the first nucleic acid test and 6 were positive in the following nucleic acid test. A total of 214 individuals were confirmed to have COVID-19 by nucleic acid tests, and the other 143 individuals were eventually diagnosed as having asymptomatic infection through IgM antibody and IgG antibody detection. There were no significant differences in CRP level, white blood cell count, lymphocyte count, platelet count, or ALT and AST among them. Therefore, the present study provided evidence for the detection of IgM and IgG antibodies as a powerful fool for the early identification of individuals with asymptomatic infections, with a sensitivity and specificity of approximately 97.1% (347 of 357) and 95.3% (204 of 214), respectively. However, there were false-negative cases, with a false-negative rate of 4.67% (10 of 214), which may be solved through the combined use of both nucleic acid tests and IgM and IgG antibody detection. Some studies indicated that false-positive results were more common where COVID-19

had been suspected and ruled out.[15] No false-positive cases were reported in the present study, which may be related with the quantity and quality of samples.

IgM is an acute phase antibody that generally appears 3 to 5 days after the onset of disease, remains positive for approximately 1 month, and then decreases. IgG is a convalescent antibody,[6,7] which is also the main component of neutralizing antibodies. IgG is generally detected a few days later than IgM, and it reaches its peak several weeks after the onset of disease; it may last for months or even years.[9] IgM-only positivity indicates early infection, and IgG-only positivity indicates convalescence or previous infection. Owing to the limited conditions, including antibody reagents, the equipment, and a shortage of doctors at that time, there were only 105 individuals who had antibody tests on days 12 and 22 from the onset of the isolation of the individuals. In the present study, it was shown that in weeks 1 to 2, IgM antibody and IgG antibody appeared successively, mainly in the individuals who were both IgM positive and IgG positive, accounting for 68.57%, while the individuals who were IgM negative and IgG positive accounted for only 10.48% (11 of 105). After 3 weeks, the IgM antibody in some individuals gradually disappeared, and the proportion of individuals who were IgM positive and IgG positive decreased to 8.57% (9 of 105), while the IgG antibody continued to be present. At the same time, the proportion of individuals who were IgM negative and IgG positive increased to 76.19% (80 of 105). Protective antibodies had developed in most individuals at that time. However, there was a surprising case of a 51-year-old in whom both IgM and IgG changed from positive on the 12th day to negative on the 22nd day. Therefore, how long IgG antibodies can last in asymptomatic infections is still unclear.

In conclusion, we highlight here the prospects of the detection of IgM and IgG antibodies against SARS-CoV-2 as a preferred method for the identification of asymptomatic SARS-CoV-2 infection, especially combined with nucleic acid detection and pulmonary CT scanning. This method needs further promotion and application in clinical practice.

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