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Original Article

Evaluation of rapid antibody test results carried out in Manavgat State Hospital

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ABSTRACT

Objectives: In our study, we aimed to evaluate the results of rapid antibody diagnostic tests performed in the context of Coronavirus disease 2019 (COVID-19) diagnosis and screening in our hospital.

Materials and methods: In this retrospective study, the results of rapid antibody tests performed in our hospital between March 2020 and July 2020 were evaluated. The age, sex, clinical cases, ward, tomography results, and polymerase chain reaction (PCR) results of the participants were analyzed retrospectively. Computed tomography results have been examined in relation between the PCR results and clinical evaluations with rapid antibody test results.

Results: A total of 208 patients were included in the study. The mean age of the patients was 50.5 years. Antibody positivity was detected in 12 patients included in the study, and the antibody positivity rate was 5.7%. While the antibody positivity rate in COVID-19 hospitalized patients with negative PCR results was 9.5%, it was 33.3% in PCR positive patients (p=0.070). Three (42.9%) of seven patients who were antibody positive and had pneumonia on computed tomography (CT) were also PCR positive. Nine (4.3%) out of the 208 patients in the entire study group were PCR positive. The antibody test was positive in all three of these patients.

Conclusion: The gold standard method in the diagnosis of COVID-19 is the reverse transcription-polymerase chain reaction test (RT-PCR). According to clinical observations, PCR test sensitivity and reliability for COVID-19 are currently unsatisfactory. Disadvantages of this method make infection control difficult during pandemic. Therefore, COVID-19 is expected that the infection screening and diagnostic test would provide accurate results in a short period of time. Since antibody tests are cost-effective, easy-to-apply, and provide rapid results, they are among the diagnostic methods that can be used throughout the country. Using a combination of molecular and serological tests during the pandemic will increase diagnosis rates and make infection control easier.

Keywords: Antibody test, COVID-19, SARS-CoV-2.

The World Health Organization (WHO) representative office in China reported pneumonia cases of unknown etiology in Wuhan, Hubei, China on the 31st of December 2019. On January 7th, 2020, the agent was identified as a novel coronavirus (2019-nCoV), which has never been detected in humans before. Then, the name of 2019-nCoV the disease was accepted as COVID-19. The World Health Organization declared it pandemic on the 11th of March as COVID-19 cases were seen in 113 countries out of China and due to the spread and severity of the virus.[1] To date, the COVID-19 pandemic has resulted in 29,737,453 confirmed cases and 937,391 deaths worldwide.[2] The first COVID-19 case in our country was identified on the 11th of March. In our country, a total of 298,039 cases have been confirmed with laboratory techniques, with 7,315 deaths so far.[3]

The gold standard method in the diagnosis of COVID-19 is the reverse transcription-polymerase chain reaction (RT-PCR) test. Collection of samples from lower and upper respiratory tracts, transportation of them and RNA extraction lead to the risk of exposure to viral droplets. False-negative cases have been reported due to problems such as enzyme inhibitors and inappropriate sample transportation.[4,5] Reverse

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transcription-polymerase chain reaction performance is affected by a variety of factors, such as sample type, infection stage in patients, sample collection skills, and quality and consistency of PCR tests used. In order to recognize the disease at an early stage and manage the treatment, an alternative diagnostic method is required in the diagnosis of COVID-19. When compared with PCR, serological tests are advantageous due to their more rapid process, lower risk of droplet transmission during sample collection, and less workload.[6] In the diagnosis of COVID-19, detection of immunoglobulin (Ig) M and IgG antibodies developing against the virus can be done with immunochromatographic assays. These tests are among the ones that can be used in diagnosis as they detect the infection at an early stage and are an easy and rapid method. A few immunochromatographic commercial kits detecting IgG/IgM antibodies against severe acute respiratory syndrome coronavirus 2 SARS-CoV-2 have recently been made available for clinical usage. However, their clinical benefits have yet to be completely evaluated.[7] Researches on SARS-CoV-2 serological tests for the rapid diagnosis and follow-up of COVID-19 infection have rapidly been updated.

This study aimed to retrospectively analyze the results of patients who were admitted to our clinic and tested with a rapid antibody test for various reasons (screening of healthcare workers, testing of determined screening groups, patients followed up in the intensive care, etc.). It was also aimed to assess the relationship between computed tomography (CT) results, PCR test results, and clinical assessments, and antibody test results by obtaining the available hospital records.

MATERIALS AND METHODS

Patients who were admitted to Manavgat State Hospital with one or more clinical symptoms of COVID-19 such as fever, cough, shortness of breath, diarrhea, fatigue, tachypnea, and loss of smell-taste between the 31st of March 2020 and 10th of July 2020 and patients who were tested in order to prevent the spread of COVID-19 disease (those who would stay in prison, those who would stay in aged care homes, healthcare workers, etc.) were included in this study. We used immunochromatographic tests of Chinese origin in our study, which provided combined results for IgM and IgG antibodies and were sent to the hospital by the Turkish Ministry of Health. For detecting COVID-19 IgM and IgG antibodies, 10 µL of serum was added to the sample port and incubated for 20-30 seconds according to the manufacturer's instructions. Then, three drops of sample buffer were added to the same sample port, and the results were interpreted after a 15-20-minute incubation period. The presence of only the control line shows a negative result, whereas the presence of both the control line and IgM or IgG antibody line shows a positive result for IgM or IgG respectively.

Ethical approval of this study was granted by the Non-Interventional Clinical Research Ethics Committee of Hatay Mustafa Kemal University, Tayfur Ata Sökmen Faculty of Medicine (27/12.11.2020). The study was conducted in accordance with the principles of the Declaration of Helsinki.

RESULTS

A total of 208 patients were divided into five groups for antibody testing. The distribution of these groups was shown in Figure 1.

Seven out of 104 healthcare workers were tested using an antibody test because they had symptoms, while the remaining 97 workers were only tested for screening purposes. Three of these healthcare workers who had symptoms received treatment as their clinical findings were compatible with COVID-19 infection. Only one of them had CT findings compatible with COVID-19, and the patient's PCR and antibody test results were positive, while the other two patients only

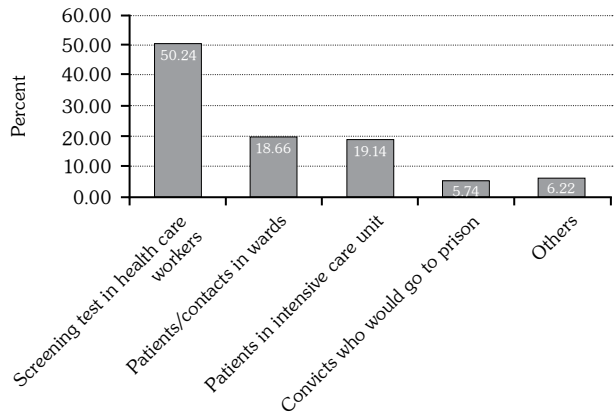

Figure 1. Test groups of the study.

Table 1. Comparison of COVID-19 patients and contacts in terms of age, sex, PCR positivity, CT positivity and clinical condition according to antibody positivity

	Antibody negative				Antibody positive				Total				
	n	%	Median	Min-Max	n	%	Median	Min-Max	n	%	Median	Min-Max	*p*
Age (year)			47	16-95			38	15-83			50.5	15-95	0.185*
Sex													0.772**†
Female	103	93.6			7	6.4			110	100.0			
Male	93	94.8			5	5.2			98	100.0			

PCR: Polymerase chain reaction; CT: Computed tomography; * Mann Whitney U Test; ** Chi-square Test; † Fisher's Exact Test.

had CT positivity. Polymerase chain reaction and antibody test results of the other six workers were negative. Antibody positivity was detected in 12 patients included in the study with a rate of 5.7%. While PCR negative patients hospitalized with COVID-19 had a rate of 9.5% antibody positivity, PCR positive patients had a rate of 33.3% antibody positivity (p=0.070). Comparison of COVID-19 patients and contacts in terms of demographic data, PCR results, CT results, and clinical condition based on antibody positivity was shown in Table 1. There was no statistically significant difference in antibody positivity in terms of age and sex (Table 1). Three (42.9%) out of seven patients who were antibody positive and had pneumonia monitored on CT were also PCR positive. While 25.6% of patients admitted to the ward were antibody positive, 2.5% of patients admitted to the intensive care unit (ICU) and 1.0% of healthcare workers were (p<0.001). While 80.0% of patients in the ICU had a suspected viral infection, the CT positivity rate was 57.1% in healthcare workers with symptoms and 37.9% in patients in the ward (p<0.001). Comparison of COVID-19 patients and contacts in terms of demographic data, PCR test results, CT results, and clinical condition according to antibody positivity was shown in Table 2.

Nine (4.3%) out of 208 patients in the entire study group were PCR positive. Antibody developed in three of these patients. The first patient's antibody was positive on the 21st day after PCR positivity, the second patient's 16th day, and the third patient's 10th day. The mean duration of developing antibody positivity was 15 days in PCR-positive patients. Antibody negativity was monitored in the remaining six patients. While antibody negativity was an expected condition in the early period, on the 42nd day, two antibody test results of a 38-year-old male patient with a travel history to Saudi Arabia and no history of chronic disease were negative.

Antibody positivity in patients hospitalized in the ward was detected on average on the 13th day of their hospital stay. One of them was in the ICU, and the other 11 were in the ward. Antibody positive and PCR negative five patients in the ward were monitored for 28 days for isolation. Their antibody test results from the first and 21st days of their hospital stay were positive, but none of them were PCR positive. While the antibody test result of a 67-year-old female patient hospitalized in the ward was positive on the day of hospitalization, it was negative on the 51st day after discharge.

Control antibody and PCR test results of 35-week pregnant women followed up in the PCR positive ward were negative after 39-week delivery.

The only healthcare worker who was antibody positive had findings compatible with COVID-19 on chest CT, and this patient's PCR test result was positive during hospitalization. After PCR positivity, while the following test results were negative on the third day they were positive on the 10th day. While the antibody test result of an antibody positive patient hospitalized in the ICU and who had findings compatible with COVID-19 on CT was negative during hospitalization, the patient's antibody test result on the 15th day of hospitalization was positive. The patient's PCR testing was negative in both 48-hour intervals.

There was a statistically significant difference between patients in the ward and those in the ICU in terms of age, PCR positivity, CT positivity, and clinical condition (p<0.05). Comparison of patients in the ward and those in the ICU in

Table 2. Comparison of COVID-19 patients and contacts in terms of age, sex, PCR positivity, CT positivity and clinical condition according to test groups

	Screening test in healthcare workers	Patients or contacts in the ward	Patients in intensive care unit	Convicts who would go to prison	Others	Total	*p*
Age (year) [Median (min.-max.)]	45 (26-60)	42.5 (15-83)	77 (44-95)	36 (24-56)	43 (31-80)	50.5 (15-95)	<0.001*
Sex (n, %)							0.032**
Female	**65 (62.5)**	20 (51.3)	16 (40.0)	3 (25.0)	6 (46.2)	110 (52.9)	
Male	39 (37.5)	19 (48.7)	**24 (60.0)**	**9 (75.0)**	7 (53.8)	98 (47.1)	
Total (n, %)	104 (100.0)	39 (100.0)	40 (100.0)	12 (100.0)	13 (100.0)	208 (100.0)	
PCR (n, %)							0.020**
Negative	15 (93.7)	23 (74.2)	38 (100.0)	4 (100.0)	5 (100.0)	85 (90.4)	
Positive	**1 (6.2)**	**8 (25.8)**	0 (0.0)	0 (0.0)	0 (0.0)	9 (9.6)	
CT (n, %)							<0.001**
Negative	3 (42.9)	8 (27.6)	6 (15.0)	2 (66.7)	5 (83.3)	24 (28.6)	
Positive	**4 (57.1)**	**11 (37.9)**	2 (5.0)	0 (0.0)	0 (0.0)	17 (20.2)	
Suspected viral infection	0 (0.0)	10 (34.5)	**32 (80)**	0 (0.0)	1 (16.7)	43 (51.2)	
Total (n, %)	7 (100.0)	29 (100.0)	40 (100.0)	3 (100.0)	23 (100.0)	84 (100.0)	
Clinical condition (n, %)							<0.001**
Good	**102 (98.1)**	**26 (66.7)**	1 (2.5)	12 (100.0)	13 (62.5)	154 (74.2)	
Moderate	2 (1.9)	12 (0.0)	10 (25.0)	0 (0.0)	0 (0.0)	24 (11.5)	
Poor	0 (0.0)	1 (2.6)	**29 (72.5)**	0 (0.0)	0 (0.0)	30 (14.4)	
Total	104 (100.0)	39 (100.0)	40 (100.0)	12 (100.0)	13 (100.0)	208 (100.0)	

PCR: Polymerase chain reaction; CT: Computed tomography; * Kruskal-Wallis test; ** Chi-square test.

Table 3. Comparison of patients in the ICU and ward in terms of age, sex, PCR positivity, CT positivity and clinical course

	Patients or contacts in the ward				Patients in ICU				
	n	%	Median	Min-Max	n	%	Median	Min-Max	*p*
Age (year)			42.5	15-83			**77**	**44-95**	<0.001*
Sex									0.314**
Female	20	51.3			16	40.0			
Male	19	48.7			24	60.0			
Total	39	100.0			40	100.0			
PCR									0.002**†
Negative	23	74.2			38	100.0			
Positive	**8**	**25.8**			0	0.0			
Total	31	100.0			38	100.0			
CT									<0.001**
Negative	8	27.6			6	15.0			
Positive	**11**	**37.9**			2	5.0			
Suspected viral infection	10	34.5			**32**	**80**			
Total	29	100.0			40	100.0			
Clinical condition									<0.001**
Good	**26**	**66.7**			1	2.5			
Moderate	12	0.0			10	25.0			
Poor	1	2.6			**29**	**72.5**			
Total	39	100.0			40	100.0			

ICU: Intensive care unit; PCR: Polymerase chain reaction; CT: Computed tomography; * Mann-Whitney U test; ** Chi-square test; † Fisher's Exact test.

terms of age, sex, PCR positivity, CT positivity, and clinical condition was shown in Table 3.

DISCUSSION

Reverse-transcription-PCR test is used as the standard diagnostic method for COVID-19 infection.[1] However, RT-PCR is an expensive test that requires a qualified laboratory and workers, and results take time. Current clinical observations reveal that the sensitivity and reliability of RT-PCR for COVID-19 are unsatisfactory. The disadvantages of this method make infection control difficult during the pandemic. That is why a rapid and accurate test for diagnosing and screening COVID-19 infection is highly desired. Rapid antibody tests are among the diagnostic methods that can be used to diagnose COVID-19 infection because they are cost-effective, easy-to-apply, and provide rapid results. Researches on SARS-CoV-2 serological tests for the rapid diagnosis and follow-up of COVID-19 infection have rapidly been updated. The determination of SARS-CoV-2 antibodies is based on the immune system's response to the pathogen. In our study, rapid antibody test results of the patients were assessed.

In our study, patients were followed up in the ward and ICU using rapid antibody tests that are commonly used for screening. Out of 208 individuals tested for antibodies, 104 were healthcare workers, 39 were ward patients, 40 were intensive care patients, 12 were convicts who would go to prison, and 13 were from the other screening groups.

Vásárhelyi et al.[8] found in their study comparing the results of PCR tests accepted as the gold standard method in detecting infection and two rapid antibody tests that the prevalence of PCR positivity in 4,864 patients was 6.3%. The sensitivity and specificity of these tests were 33.3% and 72.85%, and 35.48% and 85.02%, respectively. They revealed that as the antibody tests used in the study had low positive predictive values, they were unsuitable for screening SARS-CoV-2 infection in the general population.

In our study, 12 (5.7%) of the 208 patients tested positive for antibodies, while nine of the 93 patients tested positive for PCR. One-third of PCR-positive patients were also antibody-positive. Xie et al.[15] included a total of 56 patients in their study performed using the nucleic acid test in which IgM and IgG antibodies

could separately be detected. In that study, while 40 patients had negative PCR test results, 16 had positive results. Immunoglobulin G antibodies were found to be positive in all of the patients in the study, while IgM antibodies were found to be positive in 49 of them.[8] Another study included 150 patients who were subjected to both tested by PCR tests and a combined antibody test. The PCR test result was positive in 97 patients and the antibody test result was positive in 71 patients. Sixty-nine (71.1%) of 97 patients who had a positive PCR test result were antibody positive.[9] In their study of 29 PCR-positive patients, Hoffman et al.[10] reported that IgM and IgG antibody sensitivities were 69% and 93.1%, respectively. In our study, patient density consisted of screening testing on healthcare workers, which could be associated with low rates of PCR positivity and antibody test positivity. Only seven out of 104 healthcare workers had symptoms of COVID-19 infection, and while 97 were asymptomatic, they were tested for screening using an antibody test. As a part of the possible cases, 11 of the 84 patients who underwent CT and 11 of the 93 patients who were tested by PCR had positive antibody test results. While the total rate of antibody positivity was 5.7%, the rate in asymptomatic patients who were examined as a part of possible cases was around 10%. In our study, 84 of 208 patients underwent CT, with 17 having symptoms of COVID-19 and 43 exhibiting indications of suspected viral infection. While patients with suspected viral infection findings did not have a positive antibody test result, seven (41.2%) of patients with CT findings compatible with COVID-19 had a positive antibody test result. Four of the 24 patients who had no findings of COVID-19 infection on CT were antibody positive. A total of 139 serum samples were collected from 112 PCR-positive patients for the clinical study comparing the separate and combined use of immunochromatographic antibody testing and chest CT. Out of 38 asymptomatic patients, 22 had CT findings, 15 were IgM positive, and 26 were antibody positive with compatible CT findings. The sensitivity rate of CT findings increased to 57.9%, antibody test positivity to 39.5%, and common positivity in the two tests to 68.4%. Out of 74 symptomatic patients, 55 had positive CT findings, 22 had IgM positive results, and 61 had both positive CT findings and positive antibody test results. Sensitivity rates were 74.3% in patients with positive CT findings, 29.7% in those with positive antibody test results, and 82.4% in patients with both tests positive.[7] While differentiating COVID-19 infection from other viral pneumonia diagnoses based on features on chest CT, the sensitivity ranged from 73 to 93% and specificity ranged from 24 to 100%.[11,12] When subgroups of our study were assessed in terms of n CT findings, three (42.8%) of seven healthcare workers and 11 (37.9%) of 29 patients had findings compatible with COVID-19 pneumonia. In a single-center study of 51 patients, while one patient had normal CT findings, the other 50 had findings consistent with COVID-19 pneumonia. While 15 of these patients were PCR negative, 35 were PCR positive. The sensitivity of CT was 98%, and the sensitivity of PCR was 71% specific in that study. The results of this study supported the use of chest CT for COVID-19 screening in patients with clinical and epidemiological features compatible with COVID-19 infection, especially when RT-PCR test results were negative.[13]

Although the gold standard diagnostic method for COVID-19 infection is PCR test, alternative diagnostic methods are still being investigated because samples cannot be adequately collected from the upper respiratory tract, there is a risk of droplet transmission during sample collection, and the results are delayed. Studies on diagnosing with chest CT have been conducted, the use of antibody tests in combination with and CT will increase the rate of accurate and timely diagnosis. In our study, three of nine PCR-positive patients were antibody positive. Positivity in these patients was monitored in tests performed on the 21st, 16th, and 10th days, respectively, followed by PCR positivity. It was observed that patients with negative antibody test results were tested with antibody tests within the first three days of their hospitalization. In PCR-positive patients, the average time it took to develop antibody positivity was 15 days.

In another study assessing the two antibodies separately, the mean duration of seroconversion was 9 days and above.[10] When the combined IgM+IgG antibody test results were assessed, it

was found that on average, 69 out of 97 PCR positive patients were antibody positive by the 9th day. Seroconversion developed 13 and six days following the onset of symptoms in the other studies in the literature.[6,14]

In the study by Shen et al.,[9] seroconversion was observed to develop later in patients with severe clinical conditions. In comparison of seroconversion times of antibody tests according to clinical conditions of the patient, both IgM and IgG antibodies developed earlier in the patient group identified as clinically severe.[15] Further studies on the comparison of seroconversion times with clinical conditions of patients are needed.

In conclusion our study was performed in a single-center, and the majority of the test results were for screening purposes. As a result, the number and diversity of participants were limited. However, our data revealed that rapid antibody tests could be used as screening tests. As antibody tests are cost-effective, easy-to-apply, and provide rapid results, they are among the diagnostic methods that can be used throughout the country. Further studies on the diagnostic value of rapid antibody tests alone or combined use are needed because the gold standard method has disadvantages and CT is inefficient in acute infections.

Declaration of conflicting interests

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REFERENCES

1. Türkiye Cumhuriyeti Sağlık Bakanlığı Halk Sağlığı Genel Müdürlüğü COVID-19 Rehberi Available at: https://covid19.saglik.gov.tr/Eklenti/38597/0/covid-19rehberigenelbilgilerepidemiyolojivetanipdf.pdf
2. World Healty Organization Coronavirus Disease (COVID-19) Dashboard. Available at: https://covid19.who.int/
3. Türkiye'deki genel koronavirüs tablosu. Available at: https://covid19.saglik.gov.tr/TR-66935/genel-koronavirus-tablosu.html
4. Lu R, Zhao X, Li J, Niu P, Yang B, Wu H, et al. Genomic characterisation and epidemiology of 2019 novel coronavirus: Implications for virus origins and receptor binding. Lancet 2020;395:565-74.
5. Yang Y, Yang M, Shen C, Wang F, Yuan J, Li J, et al. Evaluating the accuracy of different respiratory specimens in the laboratory diagnosis and monitoring the viral shedding of 2019-nCoV infections. medRxiv 2020.
6. Zhao J, Yuan Q, Wang H, Liu W, Liao X, Su Y, et al. Antibody responses to SARS-CoV-2 in patients with novel coronavirus disease 2019. Clin Infect Dis 2020;71:2027-34.
7. Imai K, Tabata S, Ikeda M, Noguchi S, Kitagawa Y, Matuoka M, et al. Clinical evaluation of an immunochromatographic IgM/IgG antibody assay and chest computed tomography for the diagnosis of COVID-19. J Clin Virol 2020;128:104393.
8. Vásárhelyi B, Kristóf K, Ostorházi E, Szabó D, Prohászka Z, Merkely B. The diagnostic value of rapid anti IgM and IgG detecting tests in the identification of patients with SARS CoV-2 virus infection. Orv Hetil 2020;161:807-12.
9. Shen B, Zheng Y, Zhang X, Zhang W, Wang D, Jin J, et al. Clinical evaluation of a rapid colloidal gold immunochromatography assay for SARS-Cov-2 IgM/IgG. Am J Transl Res 2020;12:1348-54.
10. Hoffman T, Nissen K, Krambrich J, Rönnberg B, Akaberi D, Esmaeilzadeh M, et al. Evaluation of a COVID-19 IgM and IgG rapid test; an efficient tool for assessment of past exposure to SARS-CoV-2. Infect Ecol Epidemiol 2020;10:1754538.
11. Bai HX, Hsieh B, Xiong Z, Halsey K, Choi JW, Tran TML, et al. Performance of radiologists in differentiating COVID-19 from non-COVID-19 viral pneumonia at chest CT. Radiology 2020;296:E46-E54.
12. Caruso D, Zerunian M, Polici M, Pucciarelli F, Polidori T, Rucci C, et al. Chest CT features of COVID-19 in Rome, Italy. Radiology 2020;296:E79-E85.
13. Fang Y, Zhang H, Xie J, Lin M, Ying L, Pang P, et al. Sensitivity of chest CT for COVID-19: Comparison to RT-PCR. Radiology 2020;296:E115-E117.
14. Long QX, Liu BZ, Deng HJ, Wu GC, Deng K, Chen YK, et al. Antibody responses to SARS-CoV-2 in patients with COVID-19. Nat Med 2020;26:845-8.
15. Xie J, Ding C, Li J, Wang Y, Guo H, Lu Z, et al. Characteristics of patients with coronavirus disease (COVID-19) confirmed using an IgM-IgG antibody test. J Med Virol 2020;92:2004-10.