Research Article

IT Medical Team
https://www.itmedicalteam.pl/

Health Science Journal
ISSN 1791-809X

2022
Vol. 16 No. 10: 978

Detection of SARS-CoV-2 by Rapid Antigen Tests on Saliva Expected to Lower the Impact of Post COVID-19

Zhang Lei[1]*, Yang Feng[2], Wu Yanli[2]

1 Zhejiang Gongshang University

2 Community Health Service Center, Yipeng Street, Qiantang District, Hangzhou

***Corresponding author:**
Zhang Lei

zhanglei@zjgsu.edu.cn

Zhejiang Gongshang University

Citation: Lei Z, Feng Y, Yanli W (2022) Detection of SARS-CoV-2 by Rapid Antigen Tests on Saliva Expected to Lower the Impact of Post COVID-19. Health Sci J. Vol. 16 No. 10: 978.

Abstract

Background: Most people can fully recover from coronavirus disease 2019 (COVID-19), but some may remain with long-term side effects on several systems of the body including pulmonary, cardiovascular, nervous systems, as well as psychological effects. These effects appear to be independent of aged adults and those with more initial symptoms.

Some individuals infected with SARS-CoV-2 will develop long-term symptoms. Definitions of this emerging disease vary, leading to complexity in advancing research and clinical policy development. During the pandemic, various terms have been used including long COVID, long-haul COVID, or post-COVID-19 status as used by the World Health Organization (WHO).

Despite this, a global standardized clinical case definition is still lacking. Moreover, the lack of a single terminology and clinical case definition has been repeatedly cited as a barrier to advancing research and management of these patients. Antigen Rapid Test is one of the most effective detection methods for SARS-CoV-2 infections. This method improves test efficiency and can be used at home by reading simple operating instructions. If an infection is detected and isolated immediately, it can aid in effective protection.

Aim: To explore the efficiency of rapid antigen test on saliva within impact of post COVID-19, this study aims to evaluate performance of Citest SARS-CoV-2 (COVID-19) Antigen Rapid Test (Oral Fluid) by comparing the results with RT-PCR (Nasopharyngeal swab) method.

Methods: The SARS-CoV-2 (COVID-19) Rapid Test (Oral Fluid) is a qualitative membrane-based immunoassay for the detection of SARS-CoV-2 Nucleocapsid protein Antigens in human oral fluid specimen. A clinical evaluation was conducted comparing the results obtained using the SARS-CoV-2 (COVID-19) Rapid Test (Oral Fluid) with RT-PCR (Nasopharyngeal swab) test results.

Results: Sensitivity (94.3%): In total 297 PCR confirmed positive samples: 280 PCR confirmed positive samples were correctly detected by SARS-CoV-2 (COVID-19) Rapid Test (Oral Fluid). 17 false negative cases were reported. Specificity (99.4%): In total 352 PCR confirmed negative samples: 350 PCR confirmed negative samples were correctly detected by SARS-CoV-2 (COVID-19) Rapid Test (Oral Fluid). 2 false positive cases were reported. Accuracy (97.1%): In total 649 PCR confirmed samples: 630 PCR confirmed samples were correctly detected by SARS-CoV-2 (COVID-19) Rapid Test (Oral Fluid). The observed accuracy may vary depending on the prevalence of the virus in the population.

Conclusion: Citest SARS-CoV-2 (COVID-19) Antigen Rapid Test (Oral Fluid) has potential benefit to detection, as the test kit has short turnaround times, easy to read operating procedure and can be used in decentralized testing. This finding suggests that rapid antigen testing could be an effective tool for rapid control of COVID-19. In addition, these tests can also be performed by a layperson or at home to initially identify COVID-19, which will limit the spread of the disease.

Keywords: SARS-CoV-2; Post COVID-19; Antigen Rapid Test; Saliva

Received: 10-Oct-2022, Manuscript No. iphsj-22-13117; **Editor assigned:** 13-Oct-2022, Pre-QC No. iphsj-22-13117 (PQ); **Reviewed:** 27-Oct-2022, QC No. iphsj-22-13117, **Revised:** 01-Nov-2022, Manuscript No. iphsj-22-13117 (R); **Published:** 08-Nov-2022, DOI: 10.36648/1791-809X.16.10.978

Introduction

COVID-19 is caused by the virus known as SARS-CoV-2 and is characterized by several severe complications such as acute respiratory distress syndrome, acute myocardial injury and metabolic acidosis, which causes irreversible damage, even death. COVID-19 presents with a myriad of organ involvement, variable duration of symptoms, and diverse clinical presentations that range from asymptotic infection to death [1]. At the time of writing, COVID-19 is still on-going with positive cases reaching 606 million globally in the post-pandemic era. The estimated volume of fatality rates varies greatly across countries and regions. Therefore, a large public health opportunity exists for COVID-19 rapid tests.

A subgroup of patients recovering from COVID-19 experience persistent symptoms decreased quality of life, increased dependency on others for personal care and impaired performance of daily living activities. Lasting COVID-19 symptoms or disability places obstacles for the working population upon their return to employment, posing a potential threat to communities. Manufacturers such as Abbott, Healgen, Roche, AllTest and other companies have already developed COVID-19 antigen and antibody rapid test kit. To keep up with global rapid test trends, a clinical comparison between Citest rapid antigen test and RT-PCR (Nasopharyngeal swab) was conducted.

There are three main types of COVID-19 diagnostic or screening tests: nucleic acid amplification tests, antigen tests and antibody tests. Virus antigen detection not only has all the advantages of antibody detection, but also nucleic acid detection. Thus, this article mainly focuses on antigen testing for research and discussion.

Diagnostic Methods

PCR

The most common method for detecting the specific sequence of the novel coronavirus is fluorescent quantitative PCR (polymerase chain reaction). It has characteristics of early diagnosis, high sensitivity and specificity [2], and is the "gold standard" for diagnosing novel coronavirus. Currently, the most widely used method is Real-time fluorescent quantitative RT-PCR technology [3]. Generally, the two targets located on the ORF1ab and N genes of the virus are detected. The same sample must meet the double target positive or the repeated test as the single target positive, or the two samples must meet the single target at the same time to confirm the positive of the SARS-CoV-2 virus nucleic acid. The unique gene sequence of the virus is used as the detection target [4]. Through PCR amplification, the target DNA sequence increases exponentially. Each amplified DNA sequence can be combined with a fluorescent-labeled probe that is added in advance to produce the fluorescent signal. The more target genes amplified, the stronger the accumulated fluorescent signal is displayed [4]. In samples without infection, since there is no target gene amplification, no increase in fluorescence signal would be detected. In fact, nucleic acid detection is to determine whether there is novel coronavirus nucleic acid in the sample by detecting the accumulation of fluorescent signals.

Antigen Detection

The novel coronavirus antigen test can directly detect whether the human sample specimen contains the novel coronavirus. The diagnosis is efficient, accurate, and requires less equipment and personnel than a laboratory performed PCR test. Antigens such as the N protein, E protein and S protein of the novel coronavirus can be used as immunogens to stimulate plasma cells to produce specific antibodies after the virus infects the human body. According to the principle of double-antibody sandwich ELISA, using two antigen-specific antibodies to recognize and bind to different epitopes of a target antigen can greatly reduce the probability of cross-reaction, thereby effectively improving its specificity [5]. The type of antigen test sample is generally from the site of infection, such as or pharyngeal swabs, nasopharyngeal swabs, sputum, etc [6]. The SARS-CoV-2 Antigen Rapid Test (Oral Fluid) is a rapid chromatographic immunoassay for the qualitative detection of SARS-CoV-2 nucleocapsid protein antigens in Oral Fluid specimen from individuals with suspected SARS-CoV-2 infection in conjunction with clinical presentations and the results of other laboratory tests. Results are for the detection of SARS-CoV-2 Antigens. An antigen is generally detectable in upper respiratory specimens during the acute phase of infection. Positive results indicate the presence of viral antigens, but clinical correlation with patient clinical history and other diagnostic information is necessary to determine infection status. Positive results do not rule out bacterial infection or co-infection with other viruses. The agent detected may not be the definite cause of disease. Negative results do not preclude SARS -CoV-2 infections and should not be used as the sole basis for treatment or patient management decisions. Negative results should be treated as presumptive and confirmed with a molecular assay, if necessary, for patient management. Negative results should be considered in the context of a patient's recent exposures, history and the presence of clinical signs and symptoms consistent with COVID-19. In areas with widespread transmission, rapid antigen testing can be used to detect the virus early and isolate positive cases. It is widely used in health facilities, COVID-19 testing centers/sites, nursing homes, prisons, schools, frontline and amongst health care workers [6]. Oral Fluid rapid antigen test kits are simple to operate, have high precision, convenient sample collection, and provide fast results. This allows medical personnel to perform testing with less training and understanding of the test principles, and to provide patients with rapid and novel coronavirus testing services, which can greatly reduce the overload of the medical system.

Antibody Detection

Testing for past infections is also known as antibody testing. It analyzes a sample of human blood to see if there are SARS-CoV-2 antibodies. Antibodies are a protein that the immune system makes to help identify and defend against pathogens like viruses [6]. It generally takes several weeks for some antibodies to develop, so these tests are usually not effective for detecting active infections. Seven days after the onset of novel coronavirus, serum-specific antibodies were gradually produced [6]. The immunoglobulin IgM antibodies appeared first, and then IgG antibodies appeared. In general, IgM antibody is produced

earlier. Once a person is infected, the antibody is produced quickly, maintained for a short time, and then disappears. Positive detection of IgM in blood can be used as an indicator of early infection. IgG antibody is produced later, maintained for a longer time and then disappears slowly. Positive detection of IgG in blood can be used as an indicator of infection and previous infection [7]. Therefore, an increase of IgM antibody indicates a recent acute infection, and an increase of IgG antibody indicates a previous infection. The advantages of serological testing are that it is convenient and fast, and the testing time is short. It can effectively break through the limitations of existing testing technology on patients and testing sites, and improve testing times. If the suspected case is positive for specific IgM and IgG antibodies, the IgG antibodies will change from negative to positive or the recovery period is 4 times or higher than the acute period, it can be diagnosed as infected with the novel coronavirus [8]. At present, the main antibody tests used in the United Kingdom include Abbott SARS-CoV-2 assay which detects IgG, and Roche Elecsys assay which detects IgM and IgG. Both require CLIA determination of venous blood. A Cochrane review of SARS-CoV-2 antibody tests included 57 publications on 54 cohort studies with 15,976 samples, of which 8,526 were from cases of confirmed SARS-CoV-2 infection. The accuracy of detection depends on the time of the measurement. It is an important component of the reaction, with long-term immunity and hypothesis memory for the future [8]. The United States has made great progress in antibody detection methods. The detection time ranges from 5 minutes to 2 hours, and the detection accuracy rate exceeds 90%. For example, the American Abbott Pharmaceuticals Co., Ltd. announced a novel coronavirus detection method that can determine whether someone is infected in as little as 5 minutes. The test kit is small, easy to carry, and can be used in almost any medical environment. The United States has also adopted a serum test kit that can detect whether there are antibodies to the new coronavirus in the patient within 2 minutes, thus greatly shortening the test time. South Korea uses a method where multiple samples are mixed together for testing. Once the result is positive, the sample would be tested separately. This method can greatly improve the detection efficiency, and to a certain extent alleviate the shortage of detection reagents and other materials. This test is mainly used for virus screening for asymptomatic people, so that potential infections can be quickly found in the community. This method will not be used for confirmatory testing for the time being.

Material and Methods

Specimens were collected among those routinely analyzed by RT-PCR for SARS-CoV2 diagnosis, and then swirled in 3 ml of viral transport medium (VTM), to allow the same sample of control.

Specimens were as follows:

- 352 PCR negative for SARS-CoV2 without any request for other diagnosis
- 297 PCR positive for SARS-CoV2 with condition of Ct<37, without any request for further diagnosis

The diagnosis conducted by RT-PCR (Thermo Fisher Scientific/ Applied Biosystems TaqPath™ COVID-19 CE-IVDRT-PCR Kit catalog #A48067) targeted S, N and Orf 1ab genes. To eliminate interference of relevant respiratory syndromes, samples have been pre-checked by PCR on Panther Fusion (Hologic) for Influenza A, Influenza B, Respiratory Syncytial Virus (RSV), Paramyxovirus (4 types), human Metapneumovirus, Rhino/ enterovirus and Adenovirus specimens. Extracted samples were then added to test cassettes and removed according to the instructions. Results were read and registered before the time limit.

Data among PT-PCR and Citest Antigen Rapid Test

Compared with different SARS-CoV-2 antigen rapid test data, COVID-19 antigen rapid test is a convenient method to qualitatively detect SARS-CoV-2 nucleocapsid protein antigens in human oral fluid. During testing, the specimen reacts with SARS-CoV-2 antibody-coated particles in the cassette. It then migrates upward by capillary action and combines with SARS-CoV-2 antibody. The “T” line appears as the specimen contains SARS-CoV-2 Antigens, and vice versa. To serve as a procedural control, the “C” line appears when the test has been performed correctly, indicating that the proper volume of specimen has been added and membrane wicking has occurred.

From Table 1 below, performance between PT-PCR and Citest antigen rapid test are compared by sensitivity, specificity and accuracy. The COVID-19 oral fluid antigen rapid test for self-test developed by Citest aims to qualitatively detects SARS-CoV-2. Sensitivity and specificity of detection were 94.3% and 99.4% respectively when compared with the RT-PCR method from TaqPath 1-Step RT-qPRC Master Mix kit from Thermo Fisher (**Table 1**).

PCR method

Currently, RT-PCR tests, which must be performed in a central laboratory, are considered the gold standard for detecting the presence of infectious viruses. PCR is used for qualitative and quantitative diagnosis of SARS-CoV-2, with strong specificity and relatively high sensitivity and can detect infection in the earliest stages of infection. With P3 level protection requirement, and a certified gene amplification laboratory, it represents high testing condition. Furthermore, PCR-certified personnel are also needed. With many steps, including multiple centrifugations, repeated operations such as opening the lid and adding samples, the final test results require 5 to 8 hours of processing time. Moreover, sample storage conditions are strict as RNA is easily lysed. Sample specimens should be stored at 4°C within 24 hours of collection. In the case of gene sequencing, although accuracy is

Table 1. Results of antigen diagnostics by saliva.

	PCR confirmed sample number	Correctly identified	Rate
Positive sample	297	280	94.3% (Sensitivity) (95%CI*: 91.0%~96.6%)
Negative sample	352	350	99.4% (Specificity) (95%CI*: 98.0%~99.9%)
Total	649	630	97.1% (Total Accuracy) (95%CI*: 95.5%~98.2%)

higher, it still needs to be interpreted by professionals. Based on these requirements, this method is not suitable for broad-based screening.

Rapid Test

So far, the emergence of various COVID-19 rapid tests enables us to complete the preliminary screening. Chances of contacting COVID-19 infection when outside the home are much higher than at home. While at home, people can easily test within walls of their households, and reduce the risks of spreading the infection further within his family.

Sensitivity and specificity are the two parameters for rapid test products, as they determine the extent to which the test results can be used to draw clinical and epidemiological conclusions, and to understand other evidence that might be needed. At the early stage of infection, the human body has not yet produced antibodies, which cannot be detected by measurement of an antibody rapid test. However, antigen rapid test can be used to assist in diagnosis of detecting SARS-CoV-2 infection. With high precision, convenient sample collection, and quick results, rapid antigen detection (oral fluid) is easy to operate for at home use. This allows laypersons to perform testing with little to no training, and to provide patients with rapid self-testing services, which can greatly reduce the overload of the medical system. Both tests are easy-to-use. Rapid tests can be used at or near the point-of-care, without the need for laboratory infrastructure or expensive equipment and are an alternative for SARS-CoV2 diagnosis when results are needed very quickly or lack of access to a clinical laboratory.

Conclusion

The 649 samples tested positive for SARS-CoV-2 by RT-PCR also tested positive by the Citest antigen rapid test, 99.4% concordance with SARS-CoV-2 negative results.

Citest SARS-CoV-2 (COVID-19) Antigen Rapid Test (Oral Fluid) has potential benefit to screening with short turnaround times, simplified operation procedure and decentralized testing environment. This finding suggests that rapid antigen testing could be an effective tool for COVID-19 control and prevention. In addition, these tests can also be performed by laypersons at home to identify COVID-19 infections and help limit the spread of disease.

References

1 Pan L, Mu M, Yang P, Sun Y, Wang R et al. (2020) Clinical Characteristics of COVID-19 Patients With Digestive Symptoms in Hubei, China: A Descriptive, Cross-Sectional, Multicenter Study. Am J Gastroenterol Suppl 115:766-773.

2 Mertens P, De Vos N, Martiny D, Jassoy C, Mirazimi A (2020) Development and potential usefulness of the COVID-19 Ag RespiStrip diagnostic assay in a pandemic context. Front Med 7: 225.

3 Spiteri G, MGL Monaco G (2022) Usefulness and Limitations of Anti-S IgG Assay in Detecting Previous SARS-CoV-2 Breakthrough Infection in Fully Vaccinated Healthcare Workers. Diagnostics 12:2152.

4 Rapid Detection of COVID-19 Causative Virus (SARS-CoV-2) in Human Nasopharyngeal Swab Specimens Using Field-Effect Transistor-Based Biosensor ACS Nano 22:14.

5 Giri B, Pandey S, Shrestha R, Pokharel K, Ligler FS et al. (2020) Review of analytical performance of COVID-19 detection methods. Anal Bioanal Chem 413: 35-48.

6 Kaufman HW, Chen Z, Meyer WA, Wohlgemuth JG (2021) Insights from patterns of SARS-CoV-2 immunoglobulin G serology test results from a national clinical laboratory, United States. Popul Health Manag 24:37.

7 Kaufman HW, Chen Z, Meyer WA, 3rd, Wohlgemuth JG (2021) Insights from patterns of SARS-CoV-2 immunoglobulin G serology test results from a national clinical laboratory, United States, Popul Health Manag. Med Rxiv 9: 21.

8 The Performances of Three Commercially Available Assays for the Detection of SARS-CoV Antibodies at Different Time Pionts Following SARS-Cov-2 Infection (2022). Biology, Viruses 14:2196.