REVIEW ARTICLE

Novel Diagnostic Methods in Coronavirus Testing

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ABSTRACT

Coronavirus Disease-19, an infectious disease caused by SARS-COV-2 (Severe Acute Respiratory Syndrome- Coronavirus-2) has begun at the end of 2019 causing a global pandemic. The number of cases are increasing exponentially and also so far there have been more than 3 lakh deaths. Some of the symptoms include common cold, respiratory distress and breathing difficulty. Some of the newly reported cases do not show any of the symptoms. Main diagnostic tests include RT-PCR and serologic tests, which are effective and quick. RT-PCR, ELISA (using different components), swab test, serologic test, nasopharyngeal aspirates, and chest-CT's are few of the diagnostic tests conducted to identify the state of the body. Preventative measures like self-isolation, social distancing, less interactions, mainly maintenance of good hygiene should be taken care. Due to advancement in various technologies, there is a constant search for different diagnostic testing methods to possibly find instant and accurate results, due to the drastic increase in the number of cases worldwide and has become a pandemic problem. Imaging using CT-Scan and radiographic modalities can also be used to consider the progression of the covid-19 caused by SARS-COV-2. The guaranteed treatment has still not been found but using few drugs show rapid or slow and unpredictable recovery rates. RT-PCR (Swab-test) and serologic tests are found to be instant and accurate.

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INTRODUCTION

Coronavirus which is a deadly virus has caused a drastic change effect globally because of the increasing number of cases and deaths almost all over the world. It's an infectious disease which is also referred as COVID-19 (Coronavirus Disease-19) and SARS-COV-2 (Severe Acute Respiratory Syndrome-Coronavirus-2) (Huang *et al.*, 2020). They are enveloped RNA viruses (Non- segmented, positive sense) which are mainly found in humans and mammals. The traces of this enormous outbreak was first found in Wuhan, China, 2019 (Zhu *et al.*, 2019). Everything started from pneumonia caused involving the seafood wholesale market where live animals were sold, Hubei district, China (Hui *et al.*, 2020).

Most common symptoms observed are common cold, mild to moderate respiratory distress which may subside without any special treatment. And believed that various strands of coronavirus, due to microbial variation and its extreme effects on

human health has caused bronchiolitis in children and chronic respiratory disease in older people [two of the main estimated age population (Palati *et al.*, 2020) to have weak immune systems]. Current situation: Coronavirus cases of totally 4,853,715 globally and 318,261 deaths and 1,882,853 recovered cases all over the world.

Coronavirus diagnostic testing methods currently include nasopharyngeal swab test (Alfaraj *et al.*, 2019) and throat swab test causative factors have made sure for drive thru testing of the above following to be much safer from the infectious disease.

Due to advancement in various technologies (Hannah *et al.*, 2018), there is search for different diagnostic testing methods to possibly find instant and accurate results, due to the drastic increase in the number of cases worldwide and has become a pandemic problem. Testing kits were prepared for instant and easier testing but further studies are needed to inspect whether the test kits are accurate and correct (Sheridan, 2020). Main prevention which is asked to be performed is self-isolation when minor symptoms and defects related to the infection are clinically diagnosed. Importantly good hygiene should be maintained (Poon *et al.*, 2020).

The immune system of a person will be severely impaired, [estimated age making them weak to normal infections, and these hosts are called immunocompromised hosts] due to their lack of immunity they are the majority of the people who get infected by coronavirus (Glezen, 2000).

Knowledge on the different and important aspects of current diagnostic methods for Coronavirus confirmation are the following given. Reverse transcription-RT polymerase chain reaction-PCR [processed by taking swab test from the oral cavity, collection of saliva which is the oral fluid as a diagnostic tool for drug testing (Shree *et al.*, 2019), ELISA with using nucleocapsid protein IgG and recombinant SARS-COV nucleocapsid protein based, ELISA based antibody detection tests using recombinant antigens and using cell culture extract also use of indirect immunofluorescent assay, chest CT imaging (Ai *et al.*, 2020), recombinant- protein based immunoassays for serodiagnosis of SARS -COV.

Main importance of the novel diagnostic methods and tools, will give instant and accurate results. If the test result comes out as positive it may be mild or severe, and both cases should be treated. There should be identification of the deceased and affected individuals and their recent relations in their environment to prevent further spread, but sometimes there are false positive results, which is a wrong diagnosis of the disease and it may lead to inappropriate and unwanted treatments (Krishnan *et al.*, 2018). In case of negative test results, preventive measures and self-isolation must be done. If proper precautions are followed; death rate and spreading cases will decrease but the initial step is to maintain good hygiene and healthcare (Gunasekaran and Abilasha, 2016) to overcome this pandemic lockdown and quarantine are implemented which is very much required globally.

Main aim of this review is to find the best and quickest novel diagnostic methods in COVID-19 testing to give accurate and instant results to further take action to stop its spread globally.

Diagnostic Test Methods

Chest CT for testing COVID-19

This process involves imaging of the chest and also RT-PCR, the chest CT's gave positive results way before the RT-PCR methods. Chest CT's have higher sensitivity in diagnosing Coronavirus. This study contained the following: Total no. of patients– 1014, 59% showed positive COVID-19 results in RT-PCR technique and 88% showed positive chest CT, the sensitivity of the chest CT results were 97% who were coronavirus positive patients, 75% with positive chest CT showed negative PCR technique (Ai *et al.*, 2020).

Western blot analysis and antibody ELISA

ELISA-based antibody detection tests like: Using recombinant antigens recombinant SARS-COV nucleocapsid protein tests.

Western blotting assays were conducted with recombinant SARS-COV nucleocapsid protein-based ELISA and also western blot analysis using human era tested positive for coronavirus by IgG antibody ELISA (Woo *et al.*, 2004).

RT-PCR tests

Real time -PCR are performed on collected throat swabs, till time this is considered as the best method for coronavirus testing. They are also available as RT-PCR test kits. Statistics of the study involved 4 patients, 3 patients that had coronavirus symptoms & 1 patient was initially asymptomatic but all 4 patients were tested positive for coronavirus using RT-PCR method (Lan *et al.*, 2020).

Nasopharyngeal aspirate in different human coronaviruses

The Nasopharyngeal aspirates collected showed COV-HKU I strain of coronavirus; the clinical spectrum of coronaviruses diseases were examined and found COV-HKUI, HCOV-NL63, HCOV-OC43 & HCOV-229E infections. In this study the molecular epidemiology of COV-HKU 1 were inspected, and were

tested using RT-PCR techniques.

Molecular and serological findings included 21% of 4181 patients tested positive for coronavirus but about 0.3% tested positive for type COV-HKU1 coronavirus. And it was recommended to test and collect nasopharyngeal swab instead of oropharyngeal swab for early diagnosis and higher diagnostic yields of the infectious disease (Cheng *et al.*, 2007).

Swab test

Two types nasopharyngeal swab test (NP) from the upper and lower nasopharynx and oropharynx swab test (OP), in search for the SARS-COV RNA [viral DNA are distinctive from the swabs taken and are found in an individual's genetic information (Manohar and Abilasha, 2019)] commended in collection of NP than OP for early results and diagnosis (Tang *et al.*, 2020).

Recombinant techniques

Recombinant detection techniques include phylogenetic analysis which can be a 3 step strategy to test may be whether the SARS-COV is derived from a recombinant virus or using 7 recombination region to explore and identify the presence of the SARS-COV genome recombinant (Zhu *et al.*, 2019).

Basic requirements in COVID-19 testing

Basic techniques used RT-PCR, laboratories are required for processing as the total no. of cases increase day by day and remedying testing gaps are imperative for correct results of the infections disease (Sharfstein *et al.*, 2020).

Neonatal testing for coronavirus

This study was conducted on a 15 year old who was coronavirus positive, but the testing was not directed on collection of intrauterine tissue samples like cord blood, placenta or amniotic fluid. But in this case the mother showed symptoms of coronavirus but when the neonate was tested, using RT-PCR it showed positive (Aghdam *et al.*, 2020).

Prevention

Preventive measures like self isolation, social distancing, less interaction, should be taken care and most importantly good health and hygiene must be maintained and if any symptoms show up, there should be immediate detection and testing of the disease at an earlier stage should be taken (Liang *et al.*, 2020).

Treatment

Currently, there are no vaccines invented for treating the disease at its root, by drug treatment and new modalities involving antibody treatment show much less worsening of the health (Lu, 2020).

DISCUSSION

The outbreak of coronavirus has affected all over the world, it's because of the infectious virus which can be transmitted easily through air but most of them are quite mild until there are traces of fatal and dangerous types of coronavirus like SARS-COV in 2002 and MERS-COV in 2012 (Repici *et al.*, 2020). The main cause of transmission from one person to another is through direct contact or by air droplets (Wang *et al.*, 2020), thus by decreasing healthcare provider-patient relationship interactions, drive through testing is practiced to stop its rapid spread.

This outbreak and pandemic continues, but lately has reported to represent with no proper symptoms like fever and no observation of respiratory symptoms (Guan *et al.*, 2020) and it has been noted that the coronavirus has originated from bats and was transmitted to humans (Singhal, 2020) but the type of coronavirus i.e. SARS-COV has a direct origin and has shown symptoms in 2004. The main 3 strains of coronavirus, which are known to exist, found infecting humans are: HCOV-229E, Human coronavirus-229E, SARS-COV and fourth human coronavirus (mHCOV-NL63), being a newly discovered virus.

Important laboratory testing include: Nucleic acid amplification test 9 (NAAT), such as RT-PCR (Lan *et al.*, 2020), chest CT radiographs and imaging (Ai *et al.*, 2020), western blotting and antibody (ELISA), nasopharyngeal aspirate, serologic testing is performed for coronavirus confirmation.

As there is a drastic increase in the number of positive cases of coronavirus globally, the number of neonates and carrying women with coronavirus has also increased (Zeng *et al.*, 2020), but inhibition in-vitro is subsided and created with antiviral drugs but in-utero further studies and scientific evidences needed to perform for the same, some antiviral drugs may have the ability to work like inhibitors which blocks the viral entry into our body.

Treatment for this infectious disease is still not found but treating SARS-COV -2 infection with chloroquine has, and hydroxychloroquine which acts like a potent inhibitor has shown recoveries which were reported to be effective in-vitro (Yao *et al.*, 2020). But due to lack of immediate and effective vaccines, it's recommended for people are not effective to stay indoors and isolated, social distancing and less human interactions, maintaining good hygiene and intake of Immunity boosting food will further prevent from coronavirus (Shen *et al.*, 2020).

CONCLUSION

This study has comprehensively elaborated the different novel diagnostic methods used for coronavirus testing and found that RT-PCR (by swab test) and serologic testing are the quickest and efficient method in testing coronavirus in a short span of time other imaging and radiographic modalities also can be used in testing of coronavirus.

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Conflict of Interest

The authors declare that there is no conflict of interest for this study.

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