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Review Article

EARLY DIAGNOSTIC TECHNIQUES FOR COVID-19: A COMPREHENSIVE REVIEW OF INITIAL STRATEGIES AND INNOVATIONS

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ABSTRACT

This article provides a comprehensive analysis of the early diagnosis methods used in the early phases of the COVID-19 epidemic. As the pandemic spread, the pressing need to quickly and accurately identify SARS-CoV-2 prompted the creation and application of a number of diagnostic techniques. We examine the effectiveness, drawbacks, and development of important techniques such as RT-PCR, antigen tests, and antibody assays, emphasizing the sensitivity and specificity of each. The article examines the practical difficulties in implementing these strategies and how they affect public health interventions such as quarantine and contact tracing. This article provides a detailed overview of how early diagnostic procedures affected the early response to the pandemic and lays the foundation for future advances in diagnostic techniques by combining insights from early research and practical applications.

KEYWORDS: COVID-19; SARS-CoV-2; Virus; Diagnosis; Antigen; Outbreak; Pandemic.

INTRODUCTION

The coronavirus family of viruses is characterized by a single (positive) RNA encased in a globular or polymorphic encapsulated particle that binds nucleoproteins and a protein matrix capsid. The envelope, which sticks to host cells and has significant antigenic epitopes, is made up of large glycoproteins, some of which are well-known immunosuppressive epitopes. Coronavirus infections frequently result in respiratory issues and foodborne infections.

There's no further proof that COVID-19 cannot be treated or that treating the virus with hydroxychloroquine and remdesivir is ineffective. Furthermore, testing for safety and efficacy prior to production and mass distribution is necessary in the convoluted and uncertain process of developing vaccines. This viewpoint maintained that early discovery and treatment were essential to halting the COVID-19 virus's spread. In order to investigate different comparisons and identify an optimal COVID-19 testing technique, the current work unites a novel laboratory system used to COVID-19 monitoring.

The gold standard for identifying bacterial infections is the removal of infectious organisms from cell cultures. Long-term interaction, specialized equipment, and much experimental expertise are necessary, yet it is nevertheless an efficient approach for identifying new viruses. Cell culture thinning, electrophoretic microscopy, and a positive polymerase chain reaction were used [1-23] Characteristics (RT-PCR). Furthermore, live virus transmission allows for the production of a wide range of

viruses that may be utilized in future research, such as antiviral testing, vaccine development, and model testing for isolated strains in diverse areas. Finally, successful viral research requiredquick collaboration between community science and public health institutions in research design.[24]

Classification

Based on the chemistry, replication traits, and halo-like appearance of the envelope glycoproteins, coronaviruses are classified into four types:

Alpha, beta, delta, and gammacoronaviruses are among the coronaviruses. Six distinct types of human coronaviruses have been found. Among them are the following:

HCoVHKU1

HCoV-OC43

A member of the human coronavirus (HCoV-NL63) family is the alpha-coronavirus HCoV229E.

Diagnosis

Three methods of diagnosing Covid-19 are described below: laboratory testing, molecular methods, and imaging techniques.

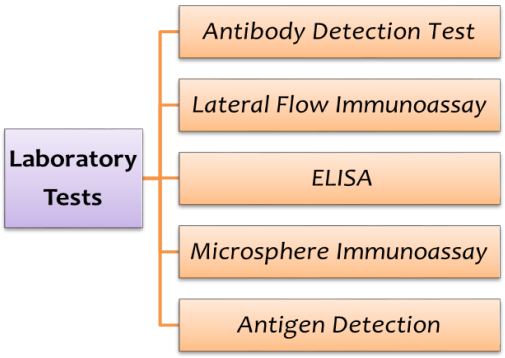

Figure 1: Different technics ofCovid-19detection.

1. Antibody Detection Test

It is possible to identify distinct antibody types, such as IgG, IgM, and IgA, using particular reagents.

The appearance of Antibodies after SARS-CoV-2 infection

IgM antibodies are very good at identifying recent infections and can be produced anywhere from 5 to 7 days after SARS-CoV-2 enters the human body.IgG antibodies can also be produced in ten to fifteen days and remain visible for several months or more. An extended period.[1]

IgA can be found in mucosal secretions in 6–8 days and is necessary for mucosal immunity.[2] The two forms of testing utilized to discover binding antibodies are laboratory testing and treatment site testing.Both innate and adaptive immunity are involved in the regulation of SARS-CoV-2 infection. The most prevalent types of antibodies are those directed against endogenous N proteins and foreign S proteins, such as neutralizing antibodies that focus on the S protein receptor-binding region.[3, 4]

The serological tests are as follows:

- Euroimmun (ELISA) – IgA, IgG Antibody detected[5]
- Maglumi(CLIA) – IgM, IgG Antibody detected[5]
- Alltest (LFA) - IgM, IgG Antibody detected[6]
- Clungene (LFA) – IgM, IgG Antibody detected[7]
- OrientGene (LFA) - IgM, IgG Antibody detected[7]
- VivaDiag (LFA) - IgM, IgG Antibody detected[7]
- StrongStep (LFA) - IgM, IgG Antibody detected[7]
- Dynamiker (LFA) - IgM, IgG Antibody detected[7]
- Multi-G (LFA) - IgM, IgG Antibody detected[7]
- Prima (LFA) - IgM, IgG Antibody detected[7]
- pGOLD assay (NanoPlasmonic Platform) - IgM, IgG Antibody detected[8]

2. Lateral Flow Immunoassay

During infection, external immunoassays are helpful for concurrently and swiftly (within 15 minutes) identifying viral IgM and IgG antibodies. In the German study, which included 49 samples from the experimental location in the upper extremities, the rapid test had a negligible impact (36.4%), but its specificity was 88.9%.[9]

3. ELISA – Enzyme-Linked Immunosorbent Assay

The low-cost ELISA test is used to check for immunizations and vaccines. The FDA's emergency support system contains four ELISA tests.[10]

According to European research, IgG and IgA levels against the SARS-CoV-2 recombinant structural protein (S1) were shown to be 91.9% and 73%, respectively, by ELISA expression.[11]

Microsphere Immunoassay

An ELISA called MIA is used to increase the quantity of antigens in a sample. It consists of carboxylic microspheres that bind to drugs, antigens, and bacterial antigens. It can be evaluated by administering a second vaccination when a patient's blood has a fluorescent signal. Although they take longer to take effect, ELISA and MIA are more efficacious than antidepressants currently available on the market.[10]

Use of the Test

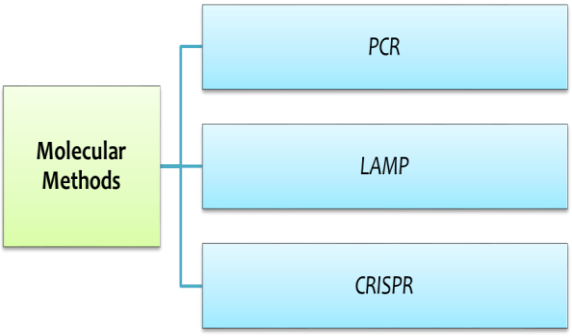

Figure 2: Molecular methods of the test.

4. Polymerase Chain Reaction

Out of PCR, instantaneous RT-PCR, and nested RT-PCR, digital droplet PCR is the most dependable RT-PCR method. RT-PCR is used to identify the nasopharynx, oropharynx, and/or small respiratory organs. At least two days after the virus has been eradicated, testing ought to be conducted.

Advantages

High sensitivity and specificity; widely used

Disadvantages

Infrastructure requirements; high cost; average turnaround time; qualified personnel; inaccurate sampling; sample transport limitations.

Indications

For both symptomatic and asymptomatic patients, this is the gold standard. For testing to yield a negative result, the infection should be detected at least two days following the test.

Advantages

Quickest turnaround time as compared to direct approaches; highest sensitivity; and least bias throughout the analytical stage.

Disadvantages

Requirements for infrastructure; •Costly; •Skilled personnel; •Inaccurate sampling; •Sample transportation limitations.

Indications

To reduce turnaround time, use RT-PCR instead of RT-PCR if at all possible.[12]

CRISPR

This recognizes bacterial illnesses including dengue fever and the Zika virus.[14]

Benefits

Economical and rapid

A method for identifying sensitive nucleic acids can help with pathogen detection at the point of care.[15]

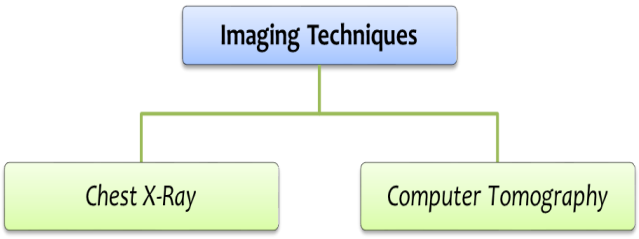

Figure 3: Method for detecting sensitive nucleic acids.

Chest X-RAY

The initial research and testing sites for COVID-19 were supposed to be CXR and X-ray equipment. It is not required to image people with minor symptoms since a CXR may not produce good results if the lung lesions are small. Among them are Ippolito and others. Lung ulcers are usually bilateral (64.5%) or lateral (60.5%) and are characterized by interstitial edoema (71.7%) or alveolar edoema (60.5%). (62.5%).[16-17]

Computer Tomography

When COVID-19 is still in its early stages, asymptomatic patients can be diagnosed with CT scans.[18]

Sensitivity

Despite its low impact (98%) CT may be helpful and is essential for determining problems and assessing the severity of a disease. To improve the level of attention.

CONCLUSION

Among other methods, molecular systems are appropriate for COVID-19 testing and are considered the gold standard. Antiretroviral therapy (ELISA, MIA, and Lateral Flow Immunoassay) is another test that can be used to demonstrate that the body is free of malignant tumors, although these processes take time. The molecular system has a greater impact than the antigen detection method. Patients who are asymptomatic or pre-symptomatic are not candidates for imaging.

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