

## **The Structure of Coronavirus and Testing for Covid-19 – A Review**

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## ABSTRACT:

Coronavirus are a group of related RNA viruses that cause disease in mammals and birds. In humans, these viruses cause respiratory tract infections that can range from mild to lethal. More lethal varieties can cause SARS(Severe Acute Respiratory Syndrome), MERS(Middle east respiratory syndrome),COVID-19. Virus first affected the domesticated animals caused by IBV.Human coronavirus was discovered in 1960s.Two novel strains B814 and 229E were subsequently imaged by electron microscopy. The information about the structure of coronavirus and the testing for COVID-19 was searched in relevant search engines and related researches.The Knowledge and current point of time analysed.The consensus was established. The structural components,Impact of Pathogenesis and Impact on testing is expalined to create a clear view about the structure and the various testing methods for the detection of the virus. The structure of coronavirus and testing for COVID-19 has been assessed and analysed.

**KEYWORD:** Coronavirus, MERS,SARS,Tests,Spread,Prevention.

## INTRODUCTION:

Coronaviruses are large, roughly spherical, particles with bulbous surface projections.(Goldsmith *et al.*, 2004)(Palati *et al.*, 2020)The average diameter of the virus particles is around 125 nm (.125  $\mu$ m). The diameter of the envelope is 85 nm and the spikes are 20 nm long. The envelope of the virus in electron micrographs appears as a distinct pair of electron-dense shells (Neuman *et al.*, 2006)(Shree *et al.*, 2019).

The viral envelope consists of a lipid bilayer, in which the membrane (M), envelope (E) and spike (S) structural proteins are anchored.(Fehr and Perlman, 2015), (Guru and Gheena, 2016)The ratio of E:S:M in the lipid bilayer is approximately 1:20:300. On average a coronavirus particle has 74 surface spikes.(Lai and Cavanagh, 1997)(Abitha and Santhanam, 2019) A subset of coronaviruses (specifically the members of betacoronavirus subgroup A) also have a shorter spike-like surface protein called hemagglutinin esterase (HE)(Cavanagh *et al.*, 2001)(Uma *et al.*, 2020).

The coronavirus surface spikes are homotrimers of the S protein, which is composed of an S1 and S2 subunit. The homotrimeric S protein is a class I fusion protein which mediates the receptor binding and membrane fusion between the virus and host cell. The S1 subunit forms the head of the spike and has the receptor binding domain (RBD). The S2 subunit forms the stem which anchors the spike in the viral envelope and on protease activation enables fusion. The E and M protein are important in forming the viral envelope and maintaining its structural shape.

Inside the envelope, there is the nucleocapsid, which is formed from multiple copies of the nucleocapsid (N) protein, which are bound to the positive-sense single-stranded RNA genome in a continuous beads-on-a-string type conformation (Neuman *et al.*, 2011), (Krishnan *et al.*, 2018). The lipid bilayer envelope, membrane proteins, and nucleocapsid protect the virus when it is outside the host cell.(De Groot *et al.*, 2011)(Palati *et al.*, 2019)

Most tests for the new strain of coronavirus involve taking swab sample for analysis. Two types of tests for the new strain of coronavirus are molecular and serological tests. Molecular tests look for signs of an active infection, Sample collected from back of the throat with a cotton swab (Chang *et al.*, 2014), (Hannah *et al.*, 2018a). The sample will undergo PCR tests, detecting signs of virus genetic material. Confirmation of presence of SARS-CoV-2 genes confirms the infection. Molecular tests help diagnose current cases. Serological tests detect antibodies that body produces to fight the virus. These antibodies are present in anyone recovered from COVID-19 (Clark, no date) (Gunasekaran and Abilasha, 2016).

The previous literature or researches reported that the spike proteins, receptor recognition, membrane fusion play a major role in the spread (Li, 2016), (Sarbeen, Insira Sarbeen and Gheena, 2016). A particular article explained that the virus rely on the protein synthesis (Fung and Liu, 2018) (Harrita and Santhanam, 2019). One more article also reported that infections can be monitored by antigen concentration (Bruning *et al.*, 2018) (Ahad and Gheena, 2016). Our team has rich experience in research and we have collaborated with numerous authors over various topics in the past decade (Ariga *et al.*, 2018; Basha, Ganapathy and Venugopalan, 2018; Hannah *et al.*, 2018b; Hussainy *et al.*, 2018; Jeevanandan and Govindaraju, 2018; Kannan and Venugopalan, 2018; Kumar and Antony, 2018; Manohar and Sharma, 2018; Menon *et al.*, 2018; Nandakumar and Nasim, 2018; Nandhini, Babu and Mohanraj, 2018; Ravinthar and Jayalakshmi, 2018; Seppan *et al.*, 2018; Teja, Ramesh and Priya, 2018; Duraisamy *et al.*, 2019; Gheena and Ezhilarasan, 2019; Hema Shree *et al.*, 2019; Rajakeerthi and Ms, 2019; Rajendran *et al.*, 2019; Sekar *et al.*, 2019; Sharma *et al.*, 2019; Siddique *et al.*, 2019; Janani, Palanivelu and Sandhya, 2020; Johnson *et al.*, 2020; Jose, Ajitha and Subbaiyan, 2020).

The main aim or objective of the review is to

- Analyse the structure of Coronavirus
- And testing for COVID-19.

## **MATERIALS AND METHODS:**

All relevant search engines (google scholar, pubmed etc.) searched for the literature pertaining to COVID-19, the structure of COVID-19 and pathogenic mechanism, testing for COVID-19 and its related searches were done. The data was collected and quality analysis of the collected data was done using Health Evidence's Quality Assessment Tool (*Health Evidence<sup>TM</sup> Quality Assessment Tool*, no date) and the data was shown in a tabular column. (Table 1). The knowledge at current point of time analysed and thus the consensus was established.

**Table 1: Quality analysis of the studies referred:**

| <b>Author Name</b>        | <b>Year</b> | <b>Quality Analysis</b> |
|---------------------------|-------------|-------------------------|
| <b>1.Gold smith</b>       | <b>2004</b> | <b>Moderate</b>         |
| <b>2.Neuman</b>           | <b>2006</b> | <b>Moderate</b>         |
| <b>3.Fehr AR</b>          | <b>2015</b> | <b>Strong</b>           |
| <b>4.Lai MM</b>           | <b>1997</b> | <b>Moderate</b>         |
| <b>5.Cavernagh</b>        | <b>2001</b> | <b>Strong</b>           |
| <b>6.Newman</b>           | <b>2011</b> | <b>Moderate</b>         |
| <b>7.de Groot</b>         | <b>2011</b> | <b>Moderate</b>         |
| <b>8.Chang C.K.</b>       | <b>2014</b> | <b>Strong</b>           |
| <b>9.Aaron</b>            | <b>2020</b> | <b>Moderate</b>         |
| <b>10.Fang Li</b>         | <b>2016</b> | <b>Strong</b>           |
| <b>11.Fung</b>            | <b>2018</b> | <b>Moderate</b>         |
| <b>12.N Ikonen</b>        | <b>2018</b> | <b>Strong</b>           |
| <b>13.RenhongYan</b>      | <b>2020</b> | <b>Moderate</b>         |
| <b>14.Yuan Yuan</b>       | <b>2017</b> | <b>Moderate</b>         |
| <b>15.Kirchdeorfer</b>    | <b>2016</b> | <b>Strong</b>           |
| <b>16.Hussin.A.Rothan</b> | <b>2020</b> | <b>Moderate</b>         |
| <b>17.Stanley</b>         | <b>2009</b> | <b>Moderate</b>         |
| <b>18.Marco</b>           | <b>2020</b> | <b>Strong</b>           |
| <b>19.Palati</b>          | <b>2020</b> | <b>Moderate</b>         |
| <b>20.Shree KH</b>        | <b>2019</b> | <b>Strong</b>           |
| <b>21.Guru PE</b>         | <b>2016</b> | <b>Moderate</b>         |
| <b>22.Tasleem Abitha</b>  | <b>2019</b> | <b>Moderate</b>         |
| <b>23.Uma PK</b>          | <b>2020</b> | <b>Moderate</b>         |

|                                 |             |                 |
|---------------------------------|-------------|-----------------|
| <b>24.Krishnan RP</b>           | <b>2018</b> | <b>Strong</b>   |
| <b>25.Palati</b>                | <b>2019</b> | <b>Moderate</b> |
| <b>26.Hannah R</b>              | <b>2019</b> | <b>Strong</b>   |
| <b>27.Gokul G</b>               | <b>2016</b> | <b>Strong</b>   |
| <b>28.Sarbeen JI</b>            | <b>2016</b> | <b>Moderate</b> |
| <b>29.Harrita S</b>             | <b>2019</b> | <b>Moderate</b> |
| <b>30.Ahad M</b>                | <b>2016</b> | <b>Moderate</b> |
| <b>31.Padavala</b>              | <b>2018</b> | <b>Moderate</b> |
| <b>32.Manohar J</b>             | <b>2019</b> | <b>Strong</b>   |
| <b>33.Ahmed Hilal Sheriff K</b> | <b>2018</b> | <b>Strong</b>   |

## **DISCUSSION:**

### **Structural components:**

The coronavirus spike protein is a multifunctional molecular machine that mediates coronavirus entry into host cells. The coronavirus spike contains three segments—a large ectodomain, a single-pass transmembrane anchor, and a short intracellular tail. The ectodomain consists of a receptor-binding subunit S1—membrane-fusion subunit S2. Electron microscopy studies revealed that the spike is a clove-shaped trimmer with three S1 heads and a trimeric S2 stalk (Yan *et al.*, 2020) (Sukumaran and Padavala, 2018)

The overall structures resemble that from other coronaviruses including HKU1, MHV and NL63 reported recently, with the exception of the receptor binding domain (RBD) (Yuan *et al.*, 2017) (Manohar and Abilasha, 2019). The protein construct contains a C-terminal T4 fibritin trimerization motif and a mutated S1/S2 furin-cleavage site. The S1 subunit adopts an extended conformation with short linkers between domains and sub-domains (Kirchdoerfer *et al.*, 2016) (Sheriff, Ahmed Hilal Sheriff and Santhanam, 2018)

### **Impact on pathogenesis:**

Patients infected with COVID-19 showed higher leukocyte numbers, abnormal respiratory findings, and increased levels of plasma pro-inflammatory cytokines— One of the COVID-19 case reports showed a patient at 5 days of fever presented with a cough, coarse breathing sounds of both lungs, and a body temperature of 39.0 °C— The patient's sputum showed positive real-

time polymerase chain reaction results that confirmed COVID-19 infection—The laboratory studies showed leucopenia with leukocyte counts of  $2.91 \times 10^9$  cells/L of which 70.0% were neutrophils.—Additionally, a value of 16.16 mg/L of blood C-reactive protein was noted which is above the normal range (0–10 mg/L).

Data indicate that SARSr-CoVs have wide geographical spread and might have been prevalent in bats for a very long time. A 5-year longitudinal study revealed the coexistence of highly diverse SARSr-CoVs in bat populations in one cave of Yunnan province, China (Rothan and Byrareddy, 2020). The recognition that SARS was caused by a coronavirus intensified the search for other pathogenic coronaviruses associated with human disease, which led to the identification of HCoV-NL63 and HCoV-HKU1. These viruses were isolated from hospitalized patients, either young children with severe respiratory disease (HCoV-NL63) or elderly patients with underlying medical problems (HCoV-HKU1) (Perlman and Netland, 2009).

### **Impact on testing:**

Testing for coronavirus can be done in various types major test are molecular and serological. Some other basic tests are:

Swab Test – In this case, a special swab is used to take a sample from your nose or throat

Nasal aspirate – In this case, a saline solution will be injected into your nose and, then a sample is taken with a light suction

Tracheal aspirate – In this case, a thin tube with a torch, also known as a bronchoscope, is put into your mouth to reach your lungs from where a sample is collected.

Sputum Test – Sputum is thick mucus that gets accumulated in the lungs and comes out with a cough. During this test, you're required to cough up sputum in a special cup or a swab is used to take a sample from your nose.

Blood test – In this case, a blood sample is taken from a vein in the arm.

A rapid test has also been started for the COVID-19, which involves taking samples from the nose, throat, and lungs. This ensures a speedy, and accurate diagnosis and is used in all CDC-approved (Mungroo, Khan and Siddiqui, 2020). Our institution is passionate about high quality evidence based research and has excelled in various fields ( (Pc, Marimuthu and Devadoss, 2018; Ramesh *et al.*, 2018; Vijayashree Priyadharsini, Smiline Girija and Paramasivam, 2018; Ezhilarasan, Apoorva and Ashok Vardhan, 2019; Ramadurai *et al.*, 2019; Sridharan *et al.*, 2019; Vijayashree Priyadharsini, 2019; Chandrasekar *et al.*, 2020; Mathew *et al.*, 2020; R *et al.*, 2020; Samuel, 2021)

### **CONCLUSION:**

COVID-19 has caused a huge damage to mankind economically, physically and mentally. So to fight against this disease being aware of it is important. This review has given detailed information about the structure of the virus and the ways to confirm the presence of the virus by tests.

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