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STRUCTURE & EVOLUTION OF COVID 19 (SARS-COV-2)

Dr. Rajeev Shah*[1], Reena Mehta[2], Ashvika Mistry[3], Manali Patel[4], Rajendra Choudhary[5] and Vivek Trivedi[6]

[1]Head & Professor, Microbiology Department, Pacific Medical College & Hospital, Udaipur, Rajesthan, India.
[2]Expert in Genetics & Cancer/Expert in DNA Technology, University of New South Wales, Australia.
[3]Turor, NaMo Medical College, Microbiology Department, Silvassa, UT, India.
[4]Ex Intern GMERS, Sola, Ahmedabad/Cardiovascular consultants of Northwest Indiana, Munster, Indiana, USA.
[5]Assistant Professor, Ophthalmology Department, AIIMS, Udaipur.
[6]Tutor, Microbiology Department, Pacific Medical College & Hospital, Udaipur, Rajesthan, India.

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***Corresponding author: Dr. Rajeev Shah**

Head & Professor, Microbiology Department, Pacific Medical College & Hospital, Udaipur, Rajesthan, India.

ABSTRACT

Coronaviridae is a family of enveloped, positive-sense, single-stranded RNA viruses. The viral genome is 26–32 kilobases in length. The particles are typically decorated with large (~20 nm), club- or petal-shaped surface projections (the "peplomers" or "spikes"), which in electron micrographs of spherical particles create an image reminiscent of the solar corona. **Coronaviruses** are a group of related RNA viruses that cause diseases in mammals and birds. In humans, these viruses cause respiratory tract infections that can range from mild to lethal. Mild illnesses include some cases of the common cold (which is also caused by other viruses, predominantly rhinoviruses), while more lethal varieties can cause SARS, MERS, and COVID-19. Symptoms in other species vary: in chickens, they cause an upper respiratory tract disease, while in cows and pigs they cause diarrhea. There are as yet no vaccines or antiviral drugs to prevent or treat human coronavirus infections. Coronaviruses constitute the subfamily ***Orthocoronavirinae***, in the family *Coronaviridae*, order *Nidovirales*, and realm *Riboviria*.[5,6] They are enveloped viruses with a positive-sense single-stranded RNA genome and a nucleocapsid of helical symmetry.[7] The genome size of coronaviruses ranges from approximately 26 to 32 kilobases, one of the largest among RNA viruses.[8] They have characteristic club-shaped spikes that project from their surface, which in electron micrographs create an image reminiscent of the solar corona, from which their name derives.[9]

KEYWORDS: Covid 19, Corona virus, Structure of Covid19, Evolution of Corona virus.

Coronaviruses are a big family of different viruses. Some of them cause the common cold in people. Others infect animals, including bats, camels, and cattle. But how did SARS-CoV-2, the new coronavirus that causes COVID-19, come into being?

Here's what we know about the virus that was first detected in Wuhan, China, in late 2019 and has set off a global pandemic.

The 5' and 3' ends of the genome have a cap and poly (A) tract, respectively. The viral envelope, obtained by budding through membranes of the endoplasmic reticulum (ER) or Golgi apparatus, invariably contains two virus-specified (glyco)protein species, S and M. Glycoprotein S comprises the large surface projections, while M is a triple-spanning transmembrane protein. Toroviruses and a select subset of coronaviruses (in particular the members of subgroup A in the genus *Betacoronavirus*) possess, in addition to the peplomers composed of S, a second type of surface projections composed of the hemagglutinin-esterase protein. Another important structural protein is the phosphoprotein N, which is responsible for the helical symmetry of the nucleocapsid that encloses the genomic RNA.[11]

Genetic recombination can occur when at least two viral genomes are present in the same infected host cell. RNA recombination appears to be a major driving force in coronavirus evolution. Recombination can determine genetic variability within a CoV species, the capability of a CoV species to jump from one host to another and, infrequently, the emergence of a novel CoV.[12] The exact mechanism of recombination in CoVs

is not known, but likely involves template switching during genome replication.[12]

Experts say SARS-CoV-2 originated in bats. That's also how the coronaviruses behind Middle East respiratory syndrome (MERS) and severe acute respiratory syndrome (SARS) got started.

SARS-CoV-2 made the jump to humans at one of Wuhan's open-air "wet markets." They're where customers buy fresh meat and fish, including animals that are killed on the spot.

Some wet markets sell wild or banned species like cobras, wild boars, and raccoon dogs. Crowded conditions can let viruses from different animals swap genes. Sometimes the virus changes so much it can start to infect and spread among people.

Still, the Wuhan market didn't sell bats at the time of the outbreak. That's why early suspicion also fell on pangolins, also called scaly anteaters, which are sold illegally in some markets in China. Some coronaviruses that infect pangolins are similar to SARS-CoV-2.

As SARS-CoV-2 spread both inside and outside China, it infected people who have had no direct contact with animals. That meant the virus is transmitted from one human to another. It's now spreading in the U.S. and around the globe, meaning that people are unwittingly catching and passing on the coronavirus. This growing worldwide transmission is what is now a pandemic.

Coronavirus Evolution

Scientists first identified a human coronavirus in 1965. It caused a common cold. Later that decade, researchers found a group of similar human and animal viruses and named them after their crown-like appearance.

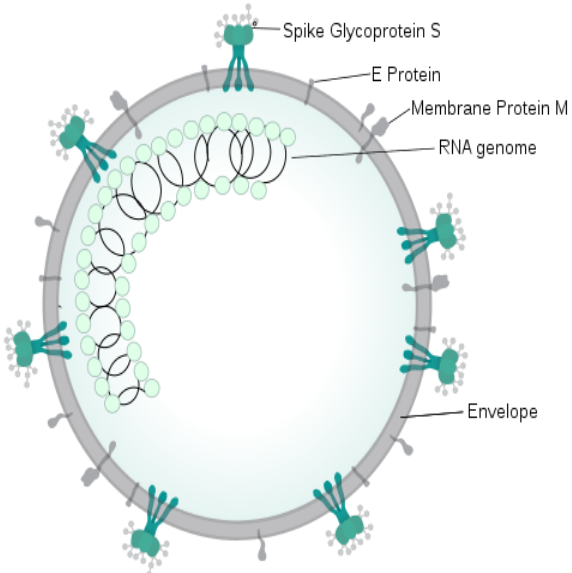
Seven coronaviruses can infect humans. The one that causes SARS emerged in southern China in 2002 and quickly spread to 28 other countries. More than 8,000 people were infected by July 2003, and 774 died. A small outbreak in 2004 involved only four more cases. This coronavirus causes fever, headache, and respiratory problems such as cough and shortness of breath.

MERS started in Saudi Arabia in 2012. Almost all of the nearly 2,500 cases have been in people who live in or travel to the Middle East. This coronavirus is less contagious than its SARS cousin but more deadly, killing 858 people. It has the same respiratory symptoms but can also cause kidney failure.

Coronaviruses didn't just pop up recently. They're a large family of viruses that have been around for a long time. Many of them can make people ill with sniffles or coughing. Before the SARS-CoV-2 outbreak, coronaviruses were thought to cause only mild respiratory infections in people.

The new (or "novel") coronavirus is one of several known to infect humans. It's probably been around for some time in animals. Sometimes, a virus in animals crosses over into people. That's what scientists think happened here. So this virus isn't new to the world, but it is new to humans. When scientists found out that it was making people sick in 2019, they named it as a novel coronavirus.

Coronavirus is the common name for Coronaviridae and Orthocoronavirinae, also called Coronavirinae.[16,17] Coronaviruses cause diseases in mammals and birds. In humans, the viruses cause respiratory infections, including the common cold, which are typically mild, though rarer forms such as SARS (including the one causing COVID-19) and MERS can be lethal.[18] Symptoms vary in other species: in chickens, they cause an upper respiratory disease, while in cows and pigs coronaviruses cause diarrhea. There are no vaccines or antiviral drugs to prevent or treat human coronavirus infections. They are enveloped viruses with a positive-sense single-stranded RNA genome and a nucleocapsid of helical symmetry. The genome size of coronaviruses ranges from approximately 26 to 32 kilobases, among the largest for an RNA virus (second only to a 41-kb nidovirus recently discovered in planaria).[19,20]



Structure of Covid 19

Human Coronavirus Types

Scientists have divided coronaviruses into four sub-groupings, called alpha, beta, gamma, and delta. Seven of these viruses can infect people. The four common ones are:

- 229E (alpha)
- NL63 (alpha)
- OC43 (beta)
- HKU1 (beta)

The three less-common ones are:

- MERS-CoV, a beta virus that causes Middle East respiratory syndrome (MERS)
- SARS-CoV, a beta virus that causes severe acute respiratory syndrome (SARS)
- SARS-CoV-2, which causes COVID-19

Why Viruses Change

Coronaviruses have all their genetic material in something called RNA (ribonucleic acid). RNA has some similarities to DNA, but they aren't the same.

When viruses infect you, they attach to your cells, get inside them, and make copies of their RNA, which helps them spread. If there's a copying mistake, the RNA gets changed. Scientists call those changes mutations.

These changes happen randomly and by accident. It's a normal part of what happens to viruses as they multiply and spread.

Because the changes are random, they may make little to no difference in a person's health. Other times, they may cause disease. For example, one reason you need a flu shot every year is because influenza viruses change from year to year. This year's flu virus probably isn't exactly the same one that circulated last year.

If a virus has a random change that makes it easier to infect people and it spreads, that strain will become more common.

The bottom line is that all viruses, including coronaviruses, can change over time. Scientists and doctors call slightly different versions of a virus new strains.

Second Coronavirus Strain

You might have heard that there's more than one strain of the new coronavirus. Is it true? The answer appears to be yes.

The theory about different strains of the new coronavirus comes from a study in China. Researchers were studying changes in coronavirus RNA over time to figure out how various coronaviruses are related to each other. They looked at 103 samples of the new coronavirus collected from people, and they looked at coronaviruses from animals. It turned out that the coronaviruses found in humans weren't all the same.

There were two types, which the researchers called "L" and "S." They're very similar, with slight differences in two places. It looks like the S type came first. But the scientists say the L type was more common early in the outbreak. One may cause more disease than the other. Scientists need more data to really know what these strains mean to human health and COVID-19.

As the corona virus keeps spreading around the world, it will probably keep changing. Experts may find new strains. It's impossible to predict how those virus changes might affect what happens. But change is just what viruses do.

With the recent detection of SARS-CoV-2, there are now seven human corona viruses. Those that cause mild diseases are the 229E, OC43, NL63 and HKU1, and the pathogenic species are SARS-CoV, MERS-CoV and SARS-CoV-2 Corona viruses (order Nidovirales, family Coronaviridae, and subfamily Orthocoronavirinae) are spherical (125nm diameter), and enveloped with club-shaped spikes on the surface giving the appearance of a solar corona. Within the helically symmetrical nucleocapsid is the large positive sense, single stranded RNA. Of the four corona virus genera (α,β,γ,δ), human corona viruses (HCoVs) are classified under α-CoV (HCoV-229E and NL63) and β-CoV (MERS-CoV, SARS-CoV, HCoVOC43 and HCoV-HKU1). SARS-CoV-2 is a β-CoV and shows fairly close relatedness with two bat-derived CoV-like coronaviruses, bat-SL-CoVZC45 and bat-SL-CoVZXC21. Even so, its genome is similar to that of the typical CoVs. SARS-CoV and MERS-CoV originated in bats, and it appears to be so for SARS-CoV-2 as well. The possibility of an intermediate host facilitating the emergence of the virus in humans has already been shown with civet cats acting as intermediate hosts for SARS-CoVs, and dromedary camels for MERS-CoV. Human-to-human transmission is primarily achieved through close contact of respiratory droplets, direct contact with the infected individuals, or by contact with contaminated objects and surfaces.

The corona viral genome contains four major structural proteins: the spike (S), membrane (M), envelope (E) and the nucleocapsid (N) protein, all of which are encoded within the 3' end of the genome. The S protein mediates attachment of the virus to the host cell surface receptors resulting in fusion and subsequent viral entry. The M protein is the most abundant protein and defines the shape of the viral envelope. The E protein is the smallest of the major structural proteins and participates in viral assembly and budding. The N protein is the only one that binds to the RNA genome and is also involved in viral assembly and budding.

Replication of corona viruses begin with attachment and entry. Attachment of the virus to the host cell is initiated by interactions between the S protein and its specific receptor. Following receptor binding, the virus enters host cell cytosol via cleavage of S protein by a protease enzyme, followed by fusion of the viral and cellular membranes. The next step is the translation of the replicase gene from the virion genomic RNA and then translation and assembly of the viral replicase complexes. Following replication and subgenomic RNA synthesis, encapsidation occurs resulting in the formation of the mature virus. Following assembly, virions are transported to the cell surface in vesicles and released by exocytosis.

In short corona virus of bat which developed spike protein S (by mutation) which can bind to angiotensin-

covering enzyme 2 (ACE 2) receptors on certain types human cells first make virus pathogenic to human and secondly its capability to hyper activate immune system of men makes it lethal or life threatening form just having limited capacity of causing common cold and flue like illness.

What makes covid 19 deadly pandemic:-The novel coronavirus, also known as SARS-CoV-2, targets type II lung cells. These cells produce soap-like substance that helps air flow deep into the lungs. But the virus causes significant damage to the lungs when it triggers the immune system to increase its activity to defend the body. To fight the corona virus, the system sends millions of cells to the infected lung tissue, which if out of control could damage the lungs.

"SARS-CoV-2 is more severe than seasonal influenza in part because it has many more ways to stop cells from calling out to the immune system for help," Neuman said in an article posted on The Conversation. "SARS-CoV-2 blocks this by a combination of camouflage, snipping off protein markers from the cell that serve as distress beacons and finally shredding any antiviral instructions that the cell makes before they can be used."

Another reason that makes COVID-19 deadly is its effects on a protein that plays an important role in blood pressure. The corona virus disrupts the ACE2 protein and prevents it from doing its job to regulate blood pressure.
Researchers have found that the corona virus could easily move from an infected person to another through exposure to droplets. In one case in South Korea, one or two people reportedly sat very close to uninfected people at a church for only a few minutes. Within two weeks, local health authorities recorded thousands of people contracted COVID-19. More than half of the cases at the time were linked to the church.

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