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Our Overall Current Knowledge of Covid 19: An Overview

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Abstract

The World Health Organization (WHO) declared COVID-19 as a public health epidemic emergency of international concern in March 2020. In just two years, this pandemic has invaded most countries and killed more than 4,800,000. The evolution of the number of cases and contaminations per day remains alarming. In May 2021, the bar of 400,000 new cases was crossed in India; this represents the highest daily number of cases recorded by a country in the history of the COVID-19 pandemic. In addition, new variants of the virus emerged in some countries. The international scientific and political community has organized itself and engaged in a race against time to find possible remedies. During this period, when people were forced to confine themselves to their homes, the way of life changed remarkably. From the declaration of the pandemic to the conception of the first vaccine, people are still in shock. This article is a short-review that explains in general what the COVID-19; the origin, biology and genetics as well as the mode of transmission and contamination of the coronavirus are discussed.

Key word: COVID-19, SARS-CoV2, pandemic.

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Background

At the end of 2019, numerous cases of pneumonia were reported in the Wuhan region of China. The disease quickly spread to the rest of the world; it was named COVID-19. Cases of early transmission would have started from seafood and live animal markets (1); investigations revealed that the disease was caused by a newly discovered member of the coronavirus family (2). On January 30, 2020, the World Health Organization (WHO) declared this epidemic as a public health emergency of international concern. Just two years later, more than a quarter of a billion cases of COVID-19 infections and 5 million deaths have been recorded worldwide (3). However, many questions arise; what is COVID-19? why the whole world is living in controversy because of this virus? What are the particularities of COVID-19 compared to already known viruses?... This article is a bibliographic collection of COVID-19; its objective is to bring together the information available to briefly explain the scourge of the 21st century pandemic.

History, nomenclature and classification

In 1968, Almeida and Tyrrell first used the term coronavirus (4); an uncharacterized human respiratory virus. This name has been given because of their crown-like morphological appearance (5). COVID-19 is an infection of the respiratory tract caused by a newly emerging coronavirus, SARS-COV-2.

Initialy designated as 2019-nCoV, the etiologic agent of COVID-19 was isolated and identified as coronavirus (6). It has been identified as a new / novel strain of β-CoV group 2B with approximately 70% genetic resemblance to SARS-CoV. WHO proposing '2019-nCoV' as an interim name of this new strain, where "n" is for novel and "CoV" is for coronavirus (7). The International Committee for Taxonomy of Viruses (3) named it "Severe Acute Respiratory Syndrome Coronavirus-2, SARS-CoV-2".

In general, coronaviruses constitute the largest group of viruses belonging to the order Nidovirales, the family

Coronaviridae. These viruses are subdivided into four genera; alpha, beta, delta and gamma coronaviruses. Only alpha and beta coronaviruses are recognized to infect humans. SARS-CoV-2, meanwhile, is a beta coronavirus (8).

Symptoms and epidemology

People with COVID-19 have a wide range of symptoms. After an incubation period varying between 2 and 14 days, different symptoms may appear (9,10,11). Some symptoms are mild, such as fever, cough, fatigue, diarrhea, or muscle pain. However, more serious symptoms appear when the disease worsens. Indeed, people of all ages are at risk of developing an intense fever and / or a cough associated with breathing difficulties or shortness of breath. Pain associated with chest pressure or loss of speech or movement may also occur (12).

The intensity of the manifestations of these symptoms depends on several factors such as, ethnicity, sex, pregnancy, certain medical conditions and the use of certain drugs, poverty and overcrowding and certain occupations, in addition, Age-related inflammation resulting from aging can lead to clinical complications from severe COVID (9,12). In general, the appearance of different symptoms is the result of biological and immune interference. In fact, the existence of a link between major histocompatibility complex (MHC) polymorphism and susceptibility to this virus is evident; the clinical outcome of SARS-Cov-2 infection depends on antiviral immune responses (13).

Globally, very few regions have escaped the pandemic. According to data from the World Health Organization, on January 1, 2021 at 8:00 a.m., a total of more than eighty million SARS-CoV-2 cases have been confirmed worldwide, including more than one million and half death. In the USA, the figures recorded were alarming, overcrowding of hospitals was observed. However, India occupied the second position and followed by Brazil. As for European countries, Russia recorded the highest rate of infection cases. On the other hand, South Africa took the top spot on the continent in terms of the number of cases of infection (12). However, it should be noted that a small percentage was recorded in China, the epicenter of the epidemic; it was estimated at only 96,762 cases of infections. This is probably due to the strict application of the health protocol and the initiation of preventive measures to fight the pandemic. Besides, in some countries, the lack of material factors and modern capacities to detect coronavirus infections had a negative influence on the amount cases of infection (12).

Contamination and transmission

The origin of the epidemic has not yet been officially determined, but SARS-CoV-2 is mainly transmitted between people through the respiratory tract (droplets and aerosols) and by contact. Interestingly, the work of Doremalen et al., (2020) demonstrated that SARS-CoV-2 remains viable in aerosols for approximately 3 hours and on different surfaces for 4 to 72 hours (14). Thus, the virus can be transmitted to those who touch contaminated surfaces. On the other hand, aerosols can form during various surgical and dental procedures; or also as droplet nuclei during the conversation, coughing and sneezing in an infected patient, suggesting that droplet formation is a potent mode of human-to-human transmission (15). Indeed, dental patients need to spit or gargle after oral procedures such as extracting, drilling, or draining a tooth abscess; which may allow transmission of the virus.

Another powerful mode of transmission is the gastrointestinal tract. Indeed, Huang et al., (2020) found SARS-CoV-2 from anal swabs in individuals of a COVID-19 positive family group (16). Also, Xing et al., (2020) found that viral shedding in the stool continues despite resolution of symptoms and radiologic findings as well as negative viral nucleic acid testing (PCR-RT) from nasopharyngeal and/or oropharyngeal specimens (17). This raises the need to include fecal testing or anal/rectal swabs to detect the possible presence of the virus before discharge; however, sharing a toilet can increase the risk of transmitting the virus.

On the other hand, by examining samples taken from furniture and fixtures in the room of an infected patient before their routine cleaning, Ong et al., (2020) found that all samples were positive for SARS-CoV 2 (18). Besides, some data implicate saliva, urine, semen and tears in the transmission of the virus. According to studies by Azzi et al., (2020) the saliva of two patients tested positive for SARS-CoV-2, while respiratory samples taken on the same day were negative (19). Furthermore, Li et al., (2020) found that sperm from 6 cases were positive, these authors suggest that the presence of the coronavirus in semen suspects its sexual transmission (20). Otherwise, more detailed data are needed to see and understand whether mother-to-child transmission was frequent.

Morphology and genetic

Examination of the cells after 3 days of infection with SARS-CoV2 revealed a specific morphology of viral particles with a size of 60 to 100 nm (21). SARS-CoV-2 has viral surface proteins, namely the spike (S) glycoprotein, which mediates the interaction with the cell surface receptor. The viral membrane glycoprotein (M) and the envelope (E) of SARS-CoV-2 are incorporated into a lipid bilayer. This is derived from the membrane of the host cell, it encapsulates the helical nucleocapsid which comprises the viral RNA (22).

The genomic organization of SARS-CoV-2 consists single-stranded RNA molecule with a positive-sense (+ ssRNA), whose size varies from 29.8 kb to 29.9 kb (23). A positive single-stranded RNA virus gives it a high replication rate, which makes it potentially pandemic (24). It encodes 29 proteins involved in the process of infection, replication and virion assembly (25,26). This genome consists of a domain of 5' cap along with a 3 'poly (A) tail and comprises 6–11 open reading frames (ORFs) (27). Each domain serves as the placeholder for genetic information that encodes several characteristics of the virus. The 5 domain represents

approximately two-thirds of the genome, this region comprises ORF1a and ORF1b. These contain the necessary information encoding the replication process of 16 nonstructural proteins of the virus (23). These proteins include two viral cysteine proteases, RNA-dependent RNA polymerase, helicase, and others that may be involved in the transcription and replication of coronavirus (27).

However, domain 3 constitutes the remaining third of the genome and encodes the structural proteins of the virus. Among these are surface (S), envelope (E), membrane (M) and nucleocapsid proteins (N). Additionally, this domain contains genetic information for accessory proteins including ORF3a, ORF6, ORF7a, ORF7b and ORF8 (23).

Replication in SARS-COV2

As with many viruses, the SARS-CoV-2 replication cycle in the host cell can be divided into several key stages. It begins with attachment and entry into the cell, transcription of the viral replicase, genomic transcription and replication, translation of structural proteins, and finally assembly and release of the virion (28,29). Initially, the spike protein (S) binds to an angiotensin-converting enzyme-2 (ACE-2), a transmembrane receptor in the host cell, and therefore initiates infection (30,31). This priming of the S protein is favored by the strong binding affinity with the ACE-2 receptor and by a host transmembrane protease 2 (TMPRSS-2) (30,32). When entering and uncapping the virus, genomic RNA (sgRNA) serves as a transcript and thus allows dependent translation of the cap of the ORF1a to produce polyprotein pp1a which are non-structure proteins (nsps) (33).

In the following stage, synthesis of viral RNA forms sub-genomic and genomic RNAs. The nsps move inside the replicase-transcriptase complex to form an environment for synthesis and replication of RNA as well as subgenomic RNAs transcription; these RNAs provide mRNAs for the transcription of structural genes (34,35,36). Consequently, the structural proteins S, E and M enter the endoplasmic reticulum and migrate within the secretory pathway to the Golgi apparatus, where the genomes are encapsidated by the N protein; these fuse in host membranes and form mature virions (28).

M and E proteins are needed for the assembly of coronaviruses (34,35,36), however, N proteins are involved in increasing the production of viral particles (28,35,36). At this stage, the S proteins are incorporated into the virions which are released outside the host cell by exocytosis (28,37).

SARS-CoV-2 Screening Methods

Two main compounds are targeted for the detection and diagnosis of SARS-CoV-2; viral RNA and antibodies produced as a result of infection. The polymerase chain reaction (PCR) technique is used for viral RNA; the nucleic acid test is essential for the diagnosis of COVID-19 from respiratory samples (38). However, antibodies or viral antigens are detected using immunological and serological assays.

In reality, these two methods complement each other; the determination of the RNA of the virus leads to the detection of the virus in its active stage, while serological tests make it possible to identify people whose immune system has already developed antibodies to fight the infection.

Computed tomography (CT) scan is also one of the high sensitivity diagnostic techniques, it is one of the auxiliary diagnostic methods needed for COVID-19. This technique is more sensitive than PCR for suspicious people, it is used to look for worsening lesions and to detect acute respiratory distress. The RT-qPCR negative tests require the combination of CT-Scan, which is more sensitive and specific test (39). For a quick response and effective intervention, high-resolution chest CT is considered an essential tool for the detection of SARS-CoV-2 (40,41,42).

Conclusion

Our understanding based on currently available data indicates that SARS Cov-2 is an international pandemic problem; the coronavirus has, in fact, crossed the borders of the whole world. The emergence of new variants of the virus is a major contributor to its widespread transmission and rapid spread compared to other coronaviruses. The consequences of the coronavirus pandemic are reflected in several sectors; political, economic, educational ... etc, this has led all countries to a new system of associative life. Fortunately, the international community's efforts to tackle Sars-Cov2 appear to be paying off, and hope looms on the horizon after some COVID-19 vaccines are designed. (43).

Ethics approval and consent to participate

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Authors' contributions

AT designed the review outline and wrote the first draft. SMLS updated the manuscript. AT and SMLS revised the manuscript. All authors read and approved the final manuscript.

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