REVIEW

Coronavirus Outbreak and Characteristics: A Mini-Review

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ABSTRACT

The world is confronting a new viral pandemic in the modern era which has spread to a large number of populations claiming thousands of lives. Although the initial epicenter of the outbreak was in Wuhan, China however a majority of cases have also arisen from several other locations. The virus which has been named SARS CoV-2 is highly contagious as its initial zoonotic transmission has changed to exponential spread of human to human. There is no vaccine or antiviral so its treatment is based on supportive and preventive measures. Risk assessment and biosafety training to handle such a situation can be adopted. The article narrates brief epidemiology, genetics, transmission, treatment and vaccine development strategies as well as lessons we are learning from the ongoing pandemic.

Keywords: coronavirus, covid-19, pandemic, epidemiology, outbreak, characteristics

INTRODUCTION

The novel coronavirus (nCovid-19) outbreak erupted from China’s city Wuhan has been declared a public health emergency by the World Health Organization (WHO) after it appeared simultaneously in a large number of countries of the world. The outbreak was thought to be started from a livestock market in the city of Wuhan located in Mainland China. (1) Within no time the infection spread to other parts of China and consequently, modern transport methods made it a pandemic infecting more than 1.4 million people in more than 200 countries territories worldwide until the first week of April 2020 (2). However, China has succeeded to overcome the quickly spreading outbreak as the infected number of new cases has dropped since mid-March. Whereas pandemic is at its peak in other countries particularly Europe and the United States of America. The severity of the pandemic is obvious from the risen death tolls of infected people which is now close to one lac approximately. The rate of mortality for China from the outbreak has been recorded 2% only (3). However, this fatality rate is variable according to the age of the patient and geographical factors in other parts of the world as a similar strain has caused several deaths in Europe and the USA and more new cases and deaths are expected. The highest fatality rate has been observed in patients with weak
immune systems or already suffering from other comorbidities like diabetes, carcinoma, and cardiovascular disease (CVD). The WHO named the new virus on 11th February 2020 as Severe Acute Respiratory Syndrome coronavirus 2 (SARS-CoV-2) as it resembled the SARS Cov outbreak of 2003 (5).

First human coronavirus was identified in 1966 (6) and besides recent outbreak, two other novel zoonotic coronaviruses (CoVs) had emerged and infected to many countries in the world, the first was in 2002 known as SARS-CoV (Severe acute respiratory syndrome coronavirus) and MERS-CoV (Middle East respiratory syndrome coronavirus). These two outbreaks jointly caused 1658 deaths worldwide. SARS-CoV infected 37 countries and MERS-CoV spread to 27 countries with a total of 8000 and 2494 infected persons respectively. Both strains caused moderate to severe respiratory symptoms leading to pneumonia in infected individuals (7). This review has been written to describe the true picture of Covid-19 severity of infection, genome structure, epidemiology, and probable vaccine development. Articles were downloaded from popular scientific search engines which are PubMed, Embase, and Google Scholar. We have presented important information from these articles.

AN EPIDEMIC INTO A PANDEMIC

The virus has crossed borders and reached too far off countries of the world. In this modern era of transportation and the global world, the virus spread is not a surprise. The virus infection was observed all over the world after its spread by turning the situation of endemic infection into a pandemic within no time. Iran faced its emergence of the first two coronavirus infected persons on 19 February 2020. Similarly, Italy, Spain, and France are at the peak of pandemic outside of China now. The virus has infected more than 200 countries and infected persons are approximately 1.5 million people worldwide (8). There are approximately 1.5 million cases worldwide and increasing exponentially. United States of America (USA) has been affected severely in the pandemic and a great number of cases have emerged from it.

VIRUS GENOME AND STRUCTURE

2019-nCoV belongs to the subfamily of Coronaviridae in the order Nidovirales. The subfamily Coronavirinae has four genera namely Alphacoronavirus, Betacoronavirus, Gammacoronavirus, and Deltacoronavirus. Its genome which is RNA in nature has single-stranded positive-sense and is surrounded by an envelope. It belongs to B lineage β-coronavirus, of the subgenus of Sarbecovirus (7). Its phylogenetic analysis revealed its 88% similarity with bat-derived, bat-SL-CoVZC45 and bat-SL-CoVZXC21 (9). The size of the genome is 30kb which has a 5′-cap and 3′poly-A tail. The RNA genome directly takes part in the translation of polyprotein resulting in the replication transcription complex formation by non-structural proteins. (9) The genome contains six ORF, the first ORF encodes 16 nsps (nsp1-16). The first ORF accounts for 70% region of the genome and the other ORF accounts for ⅓ of the genomic structure. Four main structural proteins which are spike (S), membrane (M), envelope (E) and nucleocapsid (N) proteins are encoded by this OPR. The proteins are essential for the virion assembly, as S protein is involved in the production of the spikes on the viral surface and attach to host receptors, and M proteins bind to nucleocapsid. The E proteins have an important role in assembling parts and release of the virus. N protein carry two domains which bind to the virus RNA genome and it may help in packaging of the encapsulated genome (10).

DISEASE SYMPTOMS AND DIAGNOSIS METHODS

Coronavirus symptoms include fever, dry cough, fatigue, and breathing difficulty which may progress to pneumonia and multi-organ failures (11). The presence of symptoms may be during 2-14 days of virus onset. However, like MERS some patients of Covid-19 remain asymptomatic and can also shed virus hence transmitting the infection to healthy individuals (12). To identify the virus real-time reverse transcriptase RT-PCR detection method is used however coronavirus affected persons can also be diagnosed by radiography of the lungs (13). Serum antibody-based tests have also been developed by the Wuhan Institute of Virology and Singapore. The first few cases were identified by de novo assembly and targeted PCR, which showed a 79.6% sequence
similarity to SARS-CoV BJ01 (GenBank accession number AY278488.2) (14).

TREATMENT OF SARS COVID-19

There is no current treatment of SARS disease. However, the disease can occur ranging from mild to severe in most cases. Older people aged more than 50 are mostly seen with heavy symptoms as compared to younger ones. Ventilator support is necessary for those in the acute condition of the disease. As there is no recommended drug for the Covid-19 related SARS, many research papers have been published with their experience of different medicines during the treatment of patients. In a case study on, Lim et al. 2020 demonstrated the usefulness of lopinavir/ritonavir by treating an old patient of 54 years old who was thought to bring Covid-19 from Wuhan into South Korea (15). Another study by Zhang et al 2020 showed that the use of an immune suppressor, and antiviral oseltamivir, human gamma globulin, and hormones for the two initial patients at the start of the epidemic in Wuhan (16). Anti-malarial drug chloroquine contains antiviral effects (17). There were reports of the use of chloroquine for the treatment of Covid-19 patients, however, FDA has not approved it because of limited evidence of its efficacy except in Emergency use Authorization on March 28, 2020 (18). Management of the patients with hypoxemia is addressed by the use of extracorporeal membrane oxygenation (ECMO) (19). In some countries treatment with patient convalescent sera and immunoglobulin, IgG has been started (20). Patients with severe symptoms may need an intensive care unit (ICU) and ventilator support in hospitals. Not a single broad-spectrum antiviral has been proved to be effective against SARS Covid-19 infection.

TRANSMISSION AND CONTAINMENT EFFORTS

The virus is highly contagious and its transmission is very rapid. At the initial stage, the infection source of spread was thought to be zoonotic and human to human transmission was rejected but later on, it changed its contagious nature as it spread from humans to humans very rapidly (21). The virus spreads through contact with an infected person, sneezing, coughing, touching, and air inhaling of aerosol droplets. Social contact is very important as a person to person transfer of virus is a major problem in containment efforts. A recent study showed the survival of viruses on various surfaces. According to them, coronavirus can remain alive for different periods on five environmental conditions which include aerosols, plastic, stainless steel, copper, and cardboard (22).

To prevent the spread of the outbreak, the Chinese government immediately took effective preventive measures which included shut down Wuhan city, screening of every person in and out of the other cities. Quarantine of the patients or suspected individuals for 14 days was also adopted(23). Many countries adopted these protective measures and screened all passengers entering the country. However, a large number of cases at large scales are still rising despite strict protective measures. However, the WHO has already declared its danger and matter of emergency concern. On January 30, 2020, the World Health Organization (WHO) declared the outbreak to be a Public Health Emergency of International Concern (PHEIC) (24).

VACCINE DEVELOPMENT

Since the sequencing of the genome was done, many researchers around the world are trying to make a promising vaccine against Covid-19. According to a report, there are approximately 72 vaccine candidates and 5 vaccines are under trial (25). The active institutes which are trying to develop a vaccine against Coronavirus are the Chinese Centre for Disease Control and Prevention (CCDCP), the University of Hong Kong, the Shanghai East Hospital and other universities. However, in some reports vaccines have been developed by Hong Kong researchers but it requires time for clinical trials. Three vaccine strategies are under consideration including an RNA vaccine matching a spike of the coronavirus surface which will go under trial in May 2020 (16). Another vaccine is based on DNA vaccine strategy which is under development and trials are expected in summer 2020 (17). A new strategy of vaccine development which is under consideration is to modify viral proteins via molecular clamp vaccines (18) Many other efforts to develop a useful and preventive vaccine may take years.
PREVENTION

Preventive measures all revolve around social distancing and practicing effective hygiene. Use of protective gear including gloves and masks, washing hands up to the elbows for 20 seconds and disinfecting surfaces around the household and workplace every 24 hours. Abstaining gatherings and crowds, avoiding handshakes, hugs or any other form of physical contact is highly advised by the WHO(26). Protocols to follow when entering the home after going out to include; trying not to touch anything before washing up, removing shoes outside, leaving any bags, purses, wallet or keys in a box at the entry of the house, disinfecting mobile phones, cleaning any item brought with bleach before storing it, removing articles of clothing and placing them in a bag to be washed, carefully disposing of used masks and gloves and taking a shower if one cannot wash all exposed areas(23).

LESSON WE HAVE LEARNT SO FAR

From the current pandemic of the coronavirus, we have learned a lot of lessons. The following points are important firstly, timely awareness about the nature of the virus is always very important. The use of livestock for food has great danger and full of risk and should be avoided. Risk assessment should be determined to take a timely decision before an epidemic starts. Rapid preparedness and readiness of biosafety tools to contain the virus is an important point that should be practiced in routine life. The need of the hour is to maintain high hygiene conditions and avoid social mix-ups. The initiation of biological safety and security training in health care workers is also a necessary element.

CONTRIBUTION

Muhammad Shaheen Iqbal, Shujjah Haider, and Sannah Ahmed Essa performed the literature review and wrote the paper; the rest authors helped with the substances of review and writing of the paper; all authors read and approved the final manuscript.

CONFLICT OF INTEREST

The authors declare that they have no competing interests.

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