



A REVIEW OF CHARACTERISTICS, TRANSMISSION, MORTALITY AND TREATMENT OF SARS-COV-2

Medical Science

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ABSTRACT

Context: COVID-19 has developed into a public health emergency of international concern. Treatment of SARS-CoV-2 is limited to supportive care with no therapies or vaccines approved. It is constructive to conduct a review of characteristics, transmission, pathogenicity, mortality and treatment of SARS-CoV-2.

Evidence Acquisition: The investigation populations were the COVID-19 cases and deaths in the world. Eight databases were searched on 10 May 2020, including CNKI, PubMed, EMBASE, Google Scholar, Cochrane Library etc.

Results: SARS-CoV-2 is a highly transmittable and pathogenic virus. Bats could be the possible major reservoir of SARS-CoV-2. The rapid human to human transmit has been confirmed. The virus has been detected in 212 countries. The top 10 countries with a high fatality rate in order were Belgium 16.31%, France 14.89%, UK 14.67%, Italy 13.93%, Netherlands 12.76%, Hungary 12.66%, Sweden 12.25%, Spain 10.06%, Mexico 10.02%, and Algeria 8.89% on 10 May 2020. The fatality rate in China was 5.50%, while the fatality rate in the United States was 5.94%. Preventive measures and treatment include hand washing, social distancing, quarantine, lockdown, detection, isolation, antiviral drugs, COVID-19 convalescent plasma.

Conclusions: The researchers have made progress in the characterization of SARS-CoV-2 and are working on the therapies and vaccines. SARS-CoV-2 has high transmissibility and low fatality rate. Treatment is primarily supportive and symptomatic, though trials of antiviral drugs, COVID-19 convalescent plasma and COVID-19 vaccine are under investigation. The whole world is working hard to control the pandemic as fast as possible.

KEYWORDS

SARS-CoV-2; COVID-19; Convalescent plasma; SARS-CoV-2 vaccine

1. Context

Coronaviruses (CoVs) are zoonotic pathogens with a high mutation rate in animals and humans. CoVs belong to the genus coronavirus in the family of coronaviridae, most of which are pleomorphic RNA viruses composing of crown-shape peplomers with 85-165 nm in size¹. The recombination rates are high due to high transcription errors and RNA dependent RNA polymerase jumps². CoVs cause infections in gastrointestinal, respiratory and neurologic systems etc.

COVID-19 was first reported in Wuhan, Hubei, China in late December, 2019³. On 1 January 2020, Wuhan authorities shut down the Huanan seafood wholesale market⁴. On 7 January 2020, scientists isolated a novel coronavirus from pneumonia patients^{5,6}, followed by Wuhan lockdown on 23 January 2020⁷. Treatment of COVID-19 is limited to supportive care with no therapies or vaccines approved⁸. WHO declared COVID-19 to be a public health emergency of international concern on 30 January 2020.

It is constructive to conduct a review of characteristics, transmission, pathogenicity, mortality rate and possible treatment of COVID-19.

2. Evidence Acquisition

The investigation populations were the COVID-19 cases and deaths in the world. The total confirmed cases and deaths collected were based on data released by the National Health Commission of the People's Republic of China and the World Health Organization on 10 May. Eight databases were searched on 10 May 2020, including China National Knowledge Infrastructure (CNKI), Wanfang Data, PubMed, Medline, EMBASE, Google Scholar, Cochrane Library, International Clinical Trials Registry Platform (ICTRP)⁹.

3. Results

3.1 Characteristics of SARS-CoV-2

SARS-CoV-2 is a highly transmittable and pathogenic virus. Bats could be the possible major reservoir of SARS-CoV-2. Coronaviruses contain a positive sense ssRNA with a genome of 27-32 kb in size, and form enveloped and spherical particles of 100-160 nm in diameter. The 5' terminus encodes a polyprotein, pp1ab, which is further cleaved into 16 non-structural proteins involving in genome transcription and replication. While, 3' terminus encodes structural proteins which are envelope glycoproteins membrane, spike, envelope and nucleocapsid. Moreover, there are accessory genes which are species-specific for the replication of virus⁹. The genome of CoVs contains a variable number

(6-11) of open reading frames (ORFs)¹⁰. Two-thirds of viral RNA, mainly located in the first ORF (ORF1a/b) translates two polyproteins, namely pp1a and pp1ab. These polyproteins encode 16 non-structural proteins. While the remaining ORFs encode accessory and structural proteins.

SARS-CoV-2 uses the same cellular entry receptor, i.e. angiotensin-converting enzyme 2 (ACE2), as SARS-CoV¹¹. The virus-S-glycoprotein on the surface of coronavirus may adhere to the ACE2 receptor¹². S glycoprotein consists of two subunits, namely S1 and S2. S1 determines the virus-host range and cellular tropism with the key function domain-RBD. At the same time, S2 mediates virus-cell membrane fusion by two tandem domains, heptad repeats HR1 and HR2^{13,14}. After the fusion of membrane, viral genome RNA gets released into the cytoplasm and translates two polypeptides encoding non-structural proteins and forming replication transcriptional complex in double-membrane vesicle^{15,16}. Replication transcriptional complex continuously replicates and synthesize a nested set of sub-genomic RNAs that encode structural and accessory proteins¹⁷. Moreover, endoplasmic reticulum and golgi body mediate the new formation of chromosomal RNA. Therefore, nucleocapsid proteins and envelope glycoproteins assemble and form viral particle buds¹⁸. In the end, virus-containing vesicles get to fuse with the plasma membrane to release the virus.

3.2 Transmission of SARS-CoV-2

Animal to human transmission was the leading cause of infection at the beginning. It can be transmitted from person to person. Besides, asymptomatic individuals can also transmit the virus. Furthermore, aerosol transmission is also possible in closed spaces. The mode of transmission is believed to occur through respiratory droplets from sneezing and coughing. The incubation time may usually be within 5 to 7 days and up to 2 weeks as the most extended period from infection to symptoms was about 12.5 days¹⁹.

3.3 Mortality of SARS-CoV-2

The top 28 COVID-19 countries with more than 20000 confirmed cases in order were USA, Spain, Italy, UK, Russia, France, Germany, Brazil, Turkey, Iran, China, Canada, Peru, India, Belgium, Netherlands, Saudi Arabia, Mexico, Switzerland, Pakistan, Ecuador, Portugal, Chile, Sweden, Singapore, Belarus, Ireland, and Qatar on 10 May 2020⁷.

Excluding countries with fewer than 1,000 confirmed cases whose fatality rate does not accurately reflect the epidemic situation, the top 10 countries with a high fatality rate in order were Belgium 16.31%, France 14.89%, UK 14.67%, Italy 13.93%, Netherlands 12.76%, Hungary 12.66%, Sweden 12.25%, Spain 10.06%, Mexico 10.02%, and Algeria 8.89% on 10 May 2020⁷.

The fatality rate in China was 5.50% with 84435 confirmed cases and 4643 deaths, ranking 57th in the world, while the fatality rate in the United States was 5.94% with 134959 confirmed cases and 80101 deaths, ranking 47th in the world on 10 May 2020⁷.

The virus has been detected in 212 countries. SARS-CoV-2 is less pathogenic than SARS-CoV (10%), and MERS-CoV (40%). Estimated R_0 for SARS-CoV-2 ranges from 3.3 to 5.5, higher than SARS-CoV (R_0 :2–5) and MERS-CoV (R_0 :<1), demonstrating that SARS-CoV-2 has low fatality rate and high transmissibility⁴. Moreover, susceptible people involve the elderly and people with other medical problems, who require more attention and care⁸.

3.4 Treatment of SARS-CoV-2

WHO declared SARS-CoV-2 as a pandemic on 11 March. The United Nations has announced this pandemic situation a global health crisis in 75-year history since the formation of the United Nations. Nevertheless, primary treatment is symptomatic and supportive therapy. Recommended preventive measures include hand washing, social distancing, quarantine, lockdown, detection, isolation. The pandemic situation has led to severe global socioeconomic disruption, cancellation of sporting, academic, religious and other cultural events. Schools, colleges and universities have closed nationwide in more than 210 countries affecting more than 3.5 billion students. Healthcare staff should take protective measures such as the use of gloves, N95 masks and eye masks during the examination of patients with a suspected history of COVID-19 contact²⁰.

There is no therapies or vaccines approved, but medical staff tried hard to try out various empirical therapies. Hui reported that interferon-beta (IFN β) is the most potent interferon to reduce in-vitro replication of MERS-CoV²¹. The use of a combination of Lopinavir/Ritonavir, pegylated interferon and ribavirin proved a successful stop to this virus²². Remdesivir had high antiviral activity in epithelial cell cultures against SARS-CoV, MERS-CoV and other bat CoVs^{23,24}.

COVID-19 convalescent plasma can normalize temperature, absorb lung lesions, resolve ARDS, remove ventilation, and is an effective and safe option to treat COVID-19. The nine RCT trials will establish the efficacy of CCP for COVID-19 from the perspective of evidence-based medicine⁸.

Developing a SARS-CoV-2 vaccine is a huge task. The whole scientific community is concentrating hard to develop a vaccine against SARS-CoV-2. The team of academicians Chen Wei in China has achieved significant results in COVID-19 vaccine development which demonstrated that the Ad5 vectored vaccine is tolerable and immunogenic at 28 days post-vaccination, humoral responses peaked at day 28 post-vaccination in healthy adults, and rapid, specific T-cell responses were noted from day 14 post-vaccination²⁵.

4. CONCLUSIONS

The researchers have made progress in the characterization of SARS-CoV-2 and are working on the therapies and vaccines. SARS-CoV-2 has high transmissibility and low fatality rate. Treatment is primarily supportive and symptomatic, though trials of antiviral drugs, COVID-19 convalescent plasma and COVID-19 vaccine are under investigation. The whole world is working hard to control the pandemic as fast as possible.

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