ScientificScholar®
Knowledge is power
Publisher of Scientific Journals

https://ijmsweb.com

Indian Journal of Medical Sciences

Review Article

A review on COVID-19 for medical students

B. K. Manjunatha Goud[1], Dharmendra Sharma[2], Sreya Varanasi[3]

[1]Department of Biochemistry, RAK Medical and Health Sciences University, RAK College of Medical Science, [2]Department of Microbiology, College of Medicine Shaqra, Kingdom of Saudi Arabia, [3]Department of Microbiology, RAK Medical and Health Sciences University, RAK College of Medical Science, United Arab Emirates.

***Corresponding author:**
Sreya Varanasi,
Department of Microbiology,
RAK Medical and Health
Sciences University,
RAK College of Medical
Science, United Arab Emirates.

drsvaranasi20@gmail.com

Received : 14 April 2020
Accepted : 15 April 2020
Published : 29 May 2021

DOI
10.25259/IJMS_47_2020

Quick Response Code:

ABSTRACT

It has not been very long since the SARS-CoV 2002 and MERS-CoV 2012 epidemics. Yet again, nature has introduced SARS-CoV-2, also known as COVID-19, a highly virulent strain of the coronavirus that has its origin in the city of Wuhan, Hubei Province, China. Primarily, a zoonotic infection, the virus probably found its way to humans through infected wild bats sold in the Wuhan local market. What makes the virus virulent, is its ability to infect multiple people at once through single index case. This has led to inability to contain the virus with ease posing a significant threat to national and international health-care resources and economies. The objective of this review is to highlight the key features of the novel CoV-19 infection as per existing data for better understanding of the disease.

Keywords: Novel Coronavirus, Infection, Health, Transmission

INTRODUCTION

Coronaviruses (CoVs), primarily of zoonotic origin, made their presence felt among humans through the SARS-CoV and MERS-CoV infections not so long ago. COVID-19, a new strain of the coronavirus, is currently a pandemic, with 1,780,356 reported cases and 108,828 reported fatalities worldwide.

CoVs belong to the genus *Coronavirus* in the *Coronaviridae* family of viruses. They are pleomorphic RNA viruses, 80–160 nm in size with 2–32 kb positive polarity, possessing multiple crown-shaped peplomers. Their recombination rate is very high due to continuous development of transcription errors and RNA-dependent RNA polymerase (RdRP) jumps contribute to their high mutation rate.[1,2]

There are four genera of the CoV which are α, β, γ, and δ-CoV. All four genera do not cause serious illness among humans. Variants of the α and β genera have low pathogenicity, producing mild respiratory symptoms like the common cold. The γ and δ-CoV variants tend to infect birds. SARS-CoV and MERS-CoV are β-CoVs with the potential to produce acute respiratory distress syndrome (ARDS) associated with high mortality rates.[3]

In December 2019, SARS-CoV-2 also known as the novel CoV-19 emerged in Wuhan, Hubei Province, China. Within a month, the virus made its way to other countries. On March 11, 2020, the World Health Organization (WHO) declared COVID-19 as a pandemic.[4]

EPIDEMIOLOGY

It is hypothesized that wild bats are the reservoir of SARS-CoV-2. Theory says that infected wild bats were being traded along with livestock in the Huanan Seafood Market in Wuhan from where

nCoV-19 infected the index cases. Among humans, the virus is transmitted through nasopharyngeal droplets and fomites.[5-7]

On December 12, 2019, a case of pneumonia not caused by influenza or other known CoV was first reported in Wuhan. By December 31, 2019, 27 similar cases were diagnosed in the same province.[8,9] All cases reported a history of animal contact in the above-mentioned market.

On January 7, 2020, the Government of China announced that nCoV-19 was isolated from all the above cases.[10,11]

Like other coronavirus outbreaks, COVID-19 seems to exhibit high incidence in the spring season across the globe. Being the season of celebrations and gatherings, high population densities in smaller areas assist in the easy transmission of the virus among humans. Compounded by the increase in international travel, the above-mentioned factors pose significant difficulties for countries to contain the spread of the virus.[12]

GENETICS

According to research, SARS-CoV-2 is like SARS-CoV in 70% of its genome and to MERS-CoV in 50% of its genome. It has approximately 89% similarity with two bat-derived SARS-like CoVs.[13-15] Metagenomic next-generation sequencing revealed the entire 29,881 base pair genome of the virus with 6–11 open reading frames (ORFs).[16] Evolutionary analysis based on ORF1a/1b, S, and N genes suggests that SARS-CoV-2 was independently introduced from animals to humans.[17,18]

Two-thirds of the viral RNA, located in the first ORF (ORF1a/b), translates to two polyproteins, PP1a and PP1ab and encodes 16 non-structural proteins (NSP). One-third of the viral genome encodes four essential structural proteins and several accessory proteins that interfere with the host innate immune response:[19]

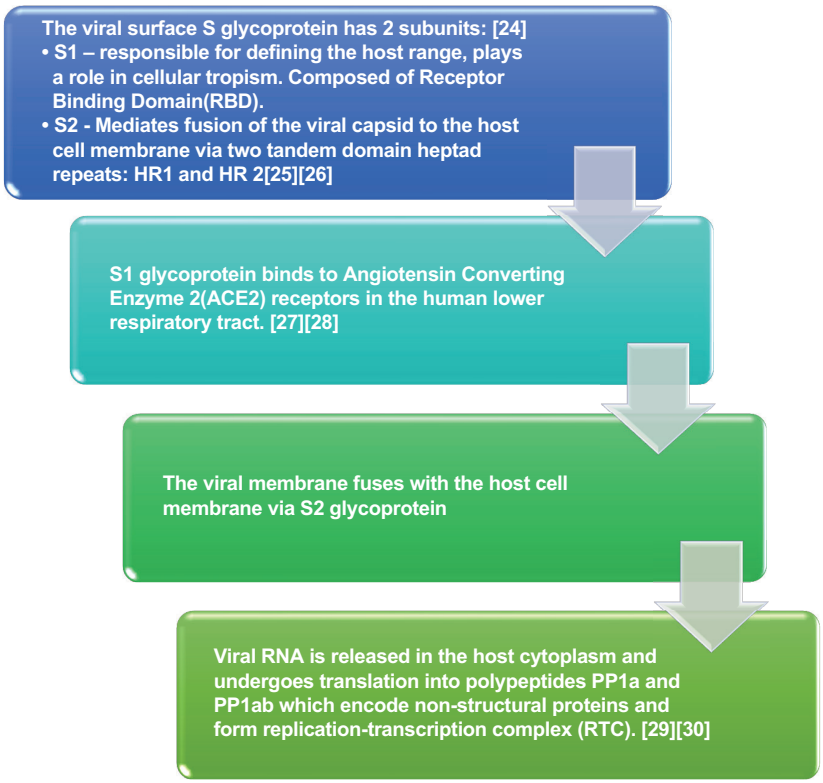
1. Spike (S) glycoprotein
2. Small envelope (E) protein
3. Matrix (M) protein
4. Nucleocapsid (N) protein

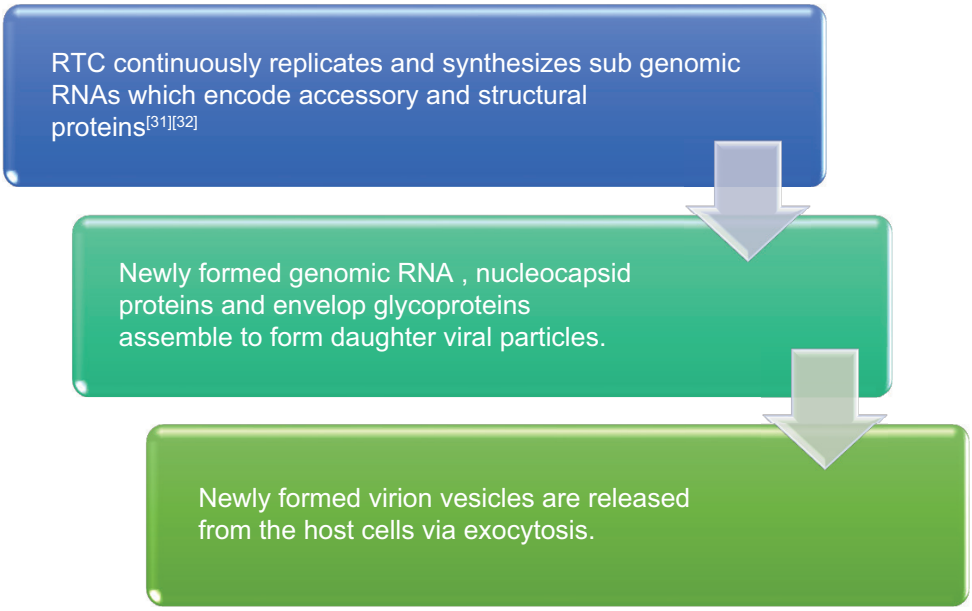
SARS-CoV-2 possesses the S-glycoprotein gene and receptor-binding domain (RBD) which confer the ability to be transmitted between two humans by direct contact.

When comparing SARS-CoV-2 with other known CoVs, no difference was found in the amino acid sequences of NSP7, NSP13, envelope, matrix, or accessory proteins p6 and 8b. A few differences were found in the NSP2, NSP3, spike protein, and underpinning subdomain (RBD).[20] Mutations in NSP2 and NSP3 play a role in the infectious potential and differentiation mechanism of the virus.[21]

Zhang *et al.*[22] found that as the virus spread across different provinces in China, its genotype exhibited several mutations.[23]

PATHOGENESIS





CLINICAL FEATURES

Viral load at the time of infection determines the clinical features in a host. The incubation period is approximately 14 days.

The most common clinical presentation is fever, headache, sore throat, productive wet cough, myalgia, diarrhea, and dyspnea.[33-35] The spectrum of clinical cases includes asymptomatic carriers and mild respiratory infection that recover within a week, severe progressive respiratory distress and death.[34,36]

In severe respiratory distress, respiratory system examination reveals reduced tactile fremitus, dullness to percussion, and reduced air entry associated with rales.

Majority of the case fatalities have been reported among the middle-aged and elderly population associated with multiple comorbidities such as diabetes mellitus, hypertension, coronary artery disease, liver cirrhosis, and cancer.[37]

INVESTIGATIONS

Investigations can be divided into two classes:

1. Tests to confirm the diagnosis of COVID 19 – a positive RT-PCR test.
2. Tests to monitor and assess the severity of the disease and its progression – performed in critically ill-hospitalized patients.

A patient is declared as recovered from the infection if two samples taken on different days give a negative RT-PCR result.

Routine blood tests include the following:

1. Complete blood count: It shows decrease in lymphocytes and white blood cells with specific reduction in CD4 and CD8 T-cells.
2. Arterial blood gas analysis.
3. Lipid profile.
4. Renal function tests.
5. Liver function tests.
6. Myocardial enzymes.
7. Urine analysis.
8. Inflammatory factors – interleukin 6 (IL-6), IL-10, and TNF-α.
9. ESR and CRP.
10. Coagulation profile with D-dimer

IMAGING

Chest X-rays are the initial imaging modality followed by CT thorax without contrast.

Clues to the diagnosis of COVID-19 on a chest X-ray are as follows:

- Bilateral lung infiltrates along the subpleural plane and bronchial vascular bundles, singular or multiple patchy, nodular, and honeycomb- or cord-like infiltrates, particularly involving the middle and lower lobes of the lung.
- Typical bilateral subsegmental ground-glass appearance
- Interlobular thickening
- Consolidation and thickening of bronchial walls

Atypical findings on imaging include:

- Pleural effusion
- Enlargement of mediastinal lymph nodes

- Single or multiple solid nodules or consolidated nodules in the center of lobule surrounded by ground-glass opacities.

CT STAGING[38]

	Stages	Type of patients	Radiological features
1	(No clinical symptoms)	Ultra-early stage Laboratory tests negative Positive throat swab	Single, double, or scattered focal ground-glass opacity Nodules located in central lobule surrounded by patchy ground-glass opacities Patchy consolidation and air bronchogram the middle and lower lobes
2	Early stage (1–3 days after onset of symptoms)	Fever cough with/without sputum	Single or multiple scattered patchy or agglomerated ground-glass opacities, separated by honeycomb-like or grid-like thickened of interlobular septa
3	Rapid progression stage	(3–7 days after the onset of symptoms)	Fused and large-scale light consolidation with air bronchogram
4	Consolidation stage.	(7–14 days after onset of symptoms)	Multiple patchy consolidations with less density as compared to rapid progression stage.
5	(2–3 weeks after onset of symptoms)	Dissipation stage	Patchy consolidation or strip-like opacity evolving into grid-like thickening of interlobular septum, thickening and strip-like twist of bronchial wall and scattered patchy consolidation

Differential diagnosis

1. Common cold caused by rhinoviruses
2. Viral pneumonia caused by influenza virus, parainfluenza virus, adenovirus, respiratory syncytial virus, and human metapneumovirus
3. Atypical pneumonia caused by mycoplasma and chlamydia
4. Bacterial pneumonia
5. Pulmonary involvement in vasculitis, dermatomyositis, and organizing pneumonia

Management

General guidelines include:

- Supportive therapy: Rest and symptomatic treatment with antipyretics, nutritional supplements, and proton-pump inhibitors/ranitidine to prevent stress ulcers.
- Self-quarantine either at home or in the hospital to break the chain of infection.
- Isolation of all suspected and confirmed cases.
- ICU care for critical cases: Mechanical ventilation and extracorporeal membrane oxygenation (ECMO).
- VTE prophylaxis: Low-molecular-weight heparin. Contraindicated in a history of recent surgery, bleeding disorders, suspected hemorrhage, active ulcers, and allergy to heparin.

Medical therapy

Antivirals:

- These drugs are not specific for treatment of SARS-CoV-2 but may help to improve the patient's overall condition.
- Example: Lopinavir, ritonavir, and interferon-alpha
- Remdesivir is a 1-cyano-substituted adenosine nucleotide analog prodrug with broad-spectrum antiviral activity against several RNA viruses. The first reported case of COVID-19 in the USA was successfully treated by remdesivir.[39]

Antimalarials:

- Chloroquine[40] shows great potential in the treatment of COVID-19 according to *in vitro* studies through the following mechanisms:
- Inhibiting pH-dependent steps of viral replication[41]
- Immunomodulatory effects through suppression of TNF and IL-6 production[42]
- Impaired glycosylation of host cell receptors for SARS-CoV-2[43-46]
- Antibiotics to prevent secondary bacterial infections
- Corticosteroids in rapid progressive disease: Its impact on length of hospital stay is yet to be determined.

Complications of covid-19

The following complications have been reported to date:[33,47]

- ARDS
- Arrhythmia
- Shock – circulatory and septic
- Acute kidney injury
- Liver dysfunction

Prevention of COVID-19

According to the WHO, by practicing the following five steps, we can successfully prevent the spread of nCoV-19 to others and avoid being infected by it ourselves:[47]

- Frequent handwashing with soap and water or an alcohol-based hand rub for at least 20 s.
- Social distancing by at least 1 m or 3 ft with people who are unwell.
- Covering the nose and mouth with a disposable tissue or a flexed elbow when coughing or sneezing. Dispose the used tissue immediately. Avoid touching your face repeatedly, especially if your hands are dirty.
- Self-isolation (#StayHome) – especially if you feel unwell.
- Seek medical attention immediately if the following symptoms develop: Fever, cough, and difficulty breathing.

At a global level, countries across the world have imposed nationwide lockdowns and public health protocols to contain the spread of COVID-19 and protect the health of their residents. Some of the measures include:

- Temporary closure of international travel
- Surveillance and screening of suspected individuals
- Isolation of infected individuals with quarantine of their close contacts
- Nationwide sterilization drives.

CONCLUSION

From the time, SARS-CoV-2 made its appearance among humankind, several researchers and health-care professionals have been risking their lives to understand the properties of the virus and aid in the recovery of infected individuals while preventing its spread among communities. By implementing lessons learned from the previous coronavirus epidemics, we can design an effective vaccine and antiviral drug that will help combat the virus. A lot more knowledge is yet to be obtained regarding the virus and the disease which will better enable us to manage patients and reduce mortality rates.

Declaration of patient consent

Patient's consent not required as there are no patients in this study.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

REFERENCES

1. Woo PC, Huang Y, Lau SK, Yuen KY. Coronavirus genomics and bioinformatics analysis. Viruses 2010;2:1804-20.
2. Drexler JF, Gloza-Rausch F, Glende J, Corman VM, Muth D, Goettsche M, *et al*. Genomic characterization of severe acute respiratory syndrome-related coronavirus in European bats and classification of coronaviruses based on partial RNA-dependent RNA polymerase gene sequences. J Virol 2010;84:11336-49.
3. Yin Y, Wunderink RG. MERS, SARS and other coronaviruses as causes of pneumonia. Respirology 2018;23:130-7.
4. Gorbalenya AE, Baker SC, Baric RS, De Groot RJ, Drosten C, Gulyaeva AA, *et al*. Severe Acute Respiratory Syndrome-Related Coronavirus: The Species and its Viruses-a Statement of the Coronavirus Study Group. BioRxiv; 2020. p. 1-15. Doi: 10.1101/2020.02.07.937862.
5. Giovanetti M, Benvenuto D, Angeletti S, Ciccozzi M. The first two cases of 2019-nCoV in Italy: Where they come from? J Med Virol 2020;92:518-21.
6. Paraskevis D, Kostaki EG, Magiorkinis G, Panayiotakopoulos G, Sourvinos G, Tsiodras S. Full-genome evolutionary analysis of the novel corona virus (2019-nCoV) rejects the hypothesis of emergence as a result of a recent recombination event. Infect Genet Evol 2020;79:104212.
7. Estimating the Potential Total Number of Novel Coronavirus Cases in Wuhan City, China; 2020. Available from: https://www.imperial.ac.uk/mrc-globalinfectiousdisease-analysis/news--wuhan-coronavirus. [Last accessed on 2020 Apr 09].
8. World Health Organization. 2019-nCoV Situation Report-22. Available from: https://www.who.int/docs/defaultsource/coronaviruse/situation-reports. [Last accessed on 2020 Feb 12].
9. European Centre for Disease Prevention and Control Data: Geographical Distribution of 2019-nCov Cases. Available from: https://www.ecdc.europa.eu/en/geographical-distribution-2019-ncov-cases. [Last accessed on 2010 Feb 05].
10. Lu R, Zhao X, Li J, Niu P, Yang B, Wu H, *et al*. Genomic characterisation and epidemiology of 2019 novel coronavirus: Implications for virus origins and receptor binding. Lancet 2020;20:30251-8.
11. Chen Z, Zhang W, Lu Y. From SARS-CoV to Wuhan 2019-nCoV Outbreak: Similarity of Early Epidemic and Prediction of Future Trends. Cell Press; 2020. Doi: 10.1101/2020.01.24.919241
12. Zhu N, Zhang D, Wang W, Li X, Yang B, Song J, *et al*. A novel coronavirus from patients with pneumonia in China, 2019. N Engl J Med 2020;382:727-33.
13. Jiang S, Du L, Shi Z. An emerging coronavirus causing pneumonia outbreak in Wuhan, China: Calling for developing therapeutic and prophylactic strategies. Emerg Microbes Infect 2020;9:275-7.
14. Song Z, Xu Y, Bao L, Zhang L, Yu P, Qu Y, *et al*. From SARS to MERS, thrusting coronaviruses into the spotlight. Viruses 2019;11:59.
15. Chen L, Liu W, Zhang Q, Xu K, Ye G, Wu W, *et al*. RNA based mNGS approach identifies a novel human coronavirus from two individual pneumonia cases in 2019 Wuhan outbreak. Emerg Microbes Infect 2020;9:313-9.
16. Zhou P, Yang XL, Wang XG, Hu B, Zhang L, Zhang W, *et al*. A pneumonia outbreak associated with a new coronavirus of probable bat origin. Nature 2020;579:270-3.
17. Cui J, Li F, Shi ZL. Origin and evolution of pathogenic coronaviruses. Nat Rev Microbiol 2019;17:181-92.
18. Wu A, Peng Y, Huang B, Ding X, Wang X, Niu P, *et al*. Genome composition and divergence of the novel coronavirus (2019-nCoV) originating in China. Cell Host Microbe 2020;27:325-8.
19. Angeletti S, Benvenuto D, Bianchi M, Giovanetti M, Pascarella S, Ciccozzi M. COVID-2019: The role of the nsp2 and nsp3 in its pathogenesis. J Med Virol 2020;92:1-4.
20. Zhang L, Shen FM, Chen F, Lin Z. Origin and evolution of the 2019 novel coronavirus. Clin Infect Dis 2020:ciaa112.
21. Wu D, Zou S, Bai T, Li J, Zhao X, Yang L, *et al*. Poultry farms as a source of avian influenza a (H7N9) virus reassortment and human infection. Sci Rep 2015;5:7630.
22. Zhang N, Jiang S, Du L. Current advancements and potential strategies in the development of MERS-CoV vaccines. Expert Rev Vaccines 2014;13:761-74.

23. Xia S, Zhu Y, Liu M, Lan Q, Xu W, Wu Y, *et al*. Fusion mechanism of 2019-nCoV and fusion inhibitors targeting HR1 domain in spike protein. Cell Mol Immunol 2020.
24. Yu F, Du L, Ojcius DM, Pan C, Jiang S. Measures for diagnosing and treating infections by a novel coronavirus responsible for a pneumonia outbreak originating in Wuhan, China. Microbes Infect 2020;22:74-9.
25. Jia HP, Look DC, Shi L, Hickey M, Pewe L, Netland J, *et al*. ACE2 receptor expression and severe acute respiratory syndrome coronavirus infection depend on differentiation of human airway epithelia. J Virol 2005;79:14614-21.
26. Tortorici MA, Veesler D. Structural insights into coronavirus entry. Adv Virus Res 2019;105:93-116.
27. De Wilde AH, Snijder EJ, Kikkert M, Van Hemert MJ. Host factors in coronavirus replication. Curr Top Microbiol Immunol 2018;419:1-42.
28. Sawicki SG, Sawicki DL. Coronavirus transcription: A perspective. Curr Top Microbiol Immunol 2005;287:31-55.
29. Hussain S, Pan J, Chen Y, Yang Y, Xu J, Peng Y, *et al*. Identification of novel subgenomic RNAs and noncanonical transcription initiation signals of severe acute respiratory syndrome coronavirus. J Virol 2005;79:5288-95.
30. Perrier A, Bonnin A, Desmarets L, Danneels A, Goffard A, Rouille Y, *et al*. The C-terminal domain of the MERS coronavirus M protein contains a trans-Golgi network localization signal. J Biol Chem 2019;294:14406-21.
31. Guan WJ, Ni ZY, Hu Y, Liang WH, Ou CQ, He JX, *et al*. Clinical characteristics of coronavirus disease 2019 in China. N Engl J Med 2020:NEJMoa2002032.
32. Centers for Disease Control and Prevention. 2019 Novel Coronavirus, Wuhan, China; 2020. Available from: https://www.cdc.gov/coronavirus/2019-nCoV/summary.html. [Last accessed on 2020 Apr 08].
33. Huang C, Wang Y, Li X, Ren L, Zhao J, Hu Y, *et al*. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. Lancet 2020;395:497-506.
34. Li T, Wei C, Li W, Hongwei F, Shi J. Beijing union medical college hospital on "pneumonia of novel coronavirus infection" diagnosis and treatment proposal (V2.0). Med J Peking Union Med Coll Hosp 2020;9:29.
35. Ying-Hui J, Lin C, Zhen-Shun C, Hong C, Tong D, Yi-Pin F, *et al*. A rapid advice guideline for the diagnosis and treatment of 2019 novel coronavirus (2019-nCoV) infected pneumonia. Military Med Res 2020;7:1-23.
36. Holshue ML, DeBolt C, Lindquist S, Lofy KH, Wiesman J, Bruce H, *et al*. First case of 2019 novel coronavirus in the United States. N Engl J Med 2020;382:929-36.
37. Aguiar AC, Murce E, Cortopassi WA, Pimentel AS, Almeida M, Barros DC, *et al*. Chloroquine analogs as antimalarial candidates with potent *in vitro* and *in vivo* activity. Int J Parasitol Drugs Drug Resist 2018;8:459-64.
38. Savarino A, Boelaert JR, Cassone A, Majori G, Cauda R. Effects of chloroquine on viral infections: An old drug against today's diseases? Lancet Infect Dis 2003;3:722-7.
39. Golden EB, Cho HY, Hofman FM, Louie SG, Schonthal AH, Chen TC. Quinoline-based antimalarial drugs: A novel class of autophagy inhibitors. Neurosurg Focus 2015;38:E12.
40. Vincent MJ, Bergeron E, Benjannet S, Erickson BR, Rollin PE, Ksiazek TG, *et al*. Chloroquine is a potent inhibitor of SARS coronavirus infection and spread. Virol J 2005;2:69.
41. Falzarano D, De Wit E, Rasmussen AL, Feldmann F, Okumura A, Scott DP, *et al*. Treatment with interferon-α2b and ribavirin improves outcome in MERS-CoV-infected rhesus macaques. Nat Med 2013;19:1313-7.
42. Chan JF, Yao Y, Yeung ML, Deng W, Bao L, Jia L, *et al*. Treatment with lopinavir/ritonavir or interferon-β1b improves outcome of MERS-CoV infection in a nonhuman primate model of common marmoset. J Infect Dis 2015;212:1904-13.
43. Omrani AS, Saad MM, Baig K, Bahloul A, Abdul-Matin M, Alaidaroos AY, *et al*. Ribavirin and interferon alfa-2a for severe middle east respiratory syndrome coronavirus infection: A retrospective cohort study. Lancet Infect Dis 2014;14:1090-5.
44. Zhao ZW, Zhang FC, Xu M, Huang K, Zhong WN, Cai WP, *et al*. Clinical analysis of 190 cases of outbreak with atypical pneumonia in Guangzhou in spring, 2003. Zhonghua Yi Xue Za Zhi 2003;83:713-8.
45. Meng QH, Dong PL, Guo YB, Zhang K, Liang LC, Hou W, *et al*. Use of glucocorticoid in treatment of severe acute respiratory syndrome cases. Zhonghua Yu Fang Yi Xue Za Zhi 2003;37:233-5.
46. Wang D, Hu B, Hu C, Zhu F, Liu X, Zhang J, *et al*. Clinical characteristics of 138 hospitalized patients with 2019 novel coronavirus-infected pneumonia in Wuhan, China. JAMA 2020;323:1061-9.
47. World Health Organization. Advice for Public; 2020. Available from: https://www.who.int/emergencies/diseases/novel-coronavirus-2019/advice-for-public. [Last accessed on 2020 Apr 09].

How to cite this article: Goud BK, Sharma D, Varanasi S. A review on COVID-19 for medical students. Indian J Med Sci 2021;73(1):30-5.