

Corona Virus: Endemic To Pandemic

Haritma Nigam¹, Takshil D Shah^{2*}, Vaibhav Pareek³, Pravin Parmar⁴, Nagendra Kumar Shetty⁵ and Sudhanshu Bhardwaj⁶

¹Assistant Professor, Department of Oral Medicine and Radiology, Pacific Dental College and Research Centre, Udaipur, India

²Consultant Prosthodontist, Chandan Multispeciality Dental Clinic, Ahmedabad, India

³Associate Professor, Department of Orthodontics, Pacific Dental College and Hospital, Udaipur, India

⁴Assistant Professor, Department of Dentistry, SMIMER Medical College, Surat, India

⁵Reader, Department of Public Health Dentistry, Sharavathi Dental College and Hospital, Shimoga, India

⁶Consultant Periodontist, Private Practitioner, Jaipur, India

***Corresponding Author:** Takshil D Shah, MDS, Prosthodontics, Chandan Multispeciality Dental Clinic Ahmedabad, India.

Received Date: 04-06-2020; **Accepted Date:** 04-17-2020; **Published Date:** 04-28-2020

Copyright © 2020 by Nigam H. All rights reserved. This is an open access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Abstract

Coronaviruses (CoVs) are imperative pathogens for human and vertebrates which can affect primarily respiratory, gastrointestinal, hepatic and central nervous system of human, domestic animals, birds, bat, mouse and many other wild animals. According to the literature, the epidemiology reported the outburst evidence of Severe Acute Respiratory Syndrome (SARS) in 2002-2003 and the Middle East Respiratory Syndrome (MERS) in 2012 have established the infectious transmission from animal-to-human and human-to-human and now the emerging pathogen is CoVs which was found anonymously in a patient suffering from pneumonia in Wuhan in December 2019 has drawn incredible care around the world.

Keywords

Coronaviruses; Middle east respiratory syndrome; Severe acute respiratory syndrome.

Introduction

In 1968, the term “coronavirus,” has been derived from the word “corona-like” or “crown-like” because of its crown like structural resemblance of the virus under electron microscope [1]. Primarily, coronaviruses causes a fatal diseases in birds and mammals but can also infect

humans and causing variation ranging from upper respiratory tract infections (URTIs) e.g. common cold to lower respiratory tract infections (LRTIs) e.g. bronchitis, pneumonia even severe acute respiratory syndrome (SARS) [2-5]. Recently, human CoVs (HCoVs) are upcoming pathogens occupying its place in both URTIs and LRTIs as agents of severe respiratory illnesses and these considered as dangerous for humans [6-8]. Coronaviruses are zoonotic pathogens affecting humans which may vary from asymptomatic to life threatening [9]. This present literature gives an overview of virology, taxonomy, and pathogenesis.

History

Even though it has been an emergent pathogen since 2019-2020 but it has started its journey 50 years back [10-15].

- **1949-** The prototype murine coronavirus was firstly reported.
- **1970-** Detailed description of molecular mechanisms of replication as well as its pathogenesis.
- **2002-2003-** Severe Acute Respiratory Syndrome (SARS) reported for the first time in Guangdong state of China. At that time CoV OC43 and CoV 229E have mostly caused mild infections in people.
- **2012-2013-** Another highly pathogenic CoV, Middle East Respiratory Syndrome Coronavirus (MERS-CoV) has emerged in the Middle East countries.
- **December 2019-2020-** Emergent of Novel Coronavirus (nCoV), at Huanan Seafood market where livestock animals are traded in Wuhan State of Hubei Province in China in a patient suffering from pneumonia epidemic of unknown cause.
- **January 7, 2020-** Isolation of a new type of Coronavirus (novel Coronavirus, nCoV) by Chinese authorities.
- **January 12 2020-** WHO named it as temporarily 2019-nCoV by WHO.
- **February 11 2020-** WHO named it as COVID-19 and as SARS-2 by International Committee on Taxonomy of Viruses (ICTV).

Epidemiology

Presently, Coronavirus came into light in December 2019, when many pneumonia cases were reported at Wuhan city and researchers found Huanan Seafood market as the origin. On December 12, 2019 the first case of the COVID-19 and 27 viral cases with unexplained pneumonia were discovered, seven being severe were officially announced on December 31, 2019.

Virion

Coronaviruses are positive-strand RNA, with the largest RNA genome enveloped viruses with round and sometimes pleomorphic virions of approximately 80 to 120 nm in diameter [16,17]. They have the largest genomes for RNA viruses. Its genome encodes four major structural proteins: the spike (S) protein, nucleocapsid (N) protein, membrane (M) protein, and the envelope (E) protein.

Figure 1: Structure of Corona Virus

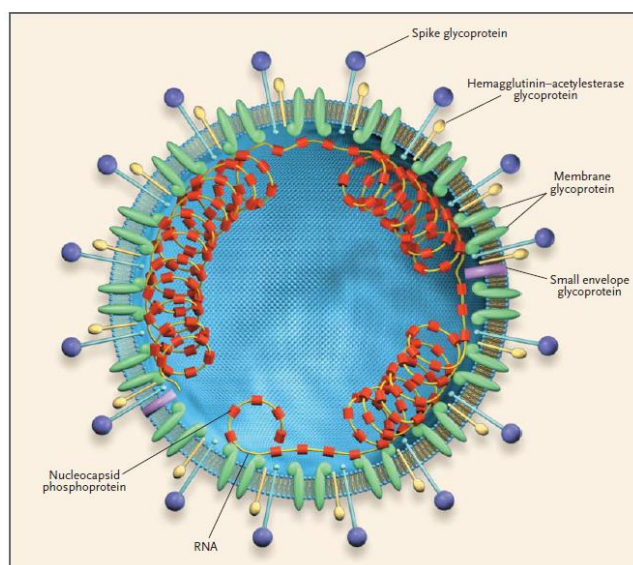


Table 1: Structural Proteins and its functions

PROTEINS [18]	FUNCTION	
SPIKE (S) PROTEIN	Type I glycoprotein	1. Gives virus its corona- or crown-like morphology under the electron microscope.
		2. Mediates attachment, fusion and its entry of the virus to the host cell
NUCLEOCAPSID (N) PROTEIN		Primarily to bind to the CoV RNA genome.
MEMBRANE(M) PROTEIN (MOST ABUNDANT)	Short N-terminal ectodomain and a cytoplasmic tail	Defines the shape of the viral envelope.
ENVELOPE (E) PROTEIN (SMALLEST)	Hydrophobic protein short ectodomain, a transmembrane domain and a cytoplasmic tail (63).	Expression inside the infected cell during replication
HEMAGGLUTININ ESTERASE (HE) (28)	An additional membrane protein in some group II	Unknown

Taxonomy

Coronaviruses (CoVs) (order Nidovirales, family Coronaviridae, subfamily Coronavirinae). On the basis of genetic and antigenic criteria, CoVs have been organized into three groups: α -CoVs, β -CoVs, and γ -CoVs (Table 2).

Table 2: Group and Species of Coronaviruses

GROUP [19]	SPECIES
α -CoV	Transmissible gastroenteritis coronavirus (TGEV)
	Canine coronavirus (CCoV)
	Porcine respiratory coronavirus (PRCoV)
	Feline coronavirus (FeCoV)
	Porcine epidemic diarrhea coronavirus (PEDV)
	Human coronavirus 229E (HCoV-229E)
	Human coronavirus NL63 (HCoV-NL63)
β -CoV	Bat coronavirus (BCoV)
	Porcine hem-agglutinating encephalomyelitis virus (HEV)
	Murine hepatitis virus (MHV)
	Human coronavirus 4408 (HCoV-4408)
	Human coronavirus OC43 (HCoV-OC43)
	Human coronavirus HKU1 (HCoV-HKU1)
	Severe acute respiratory syndrome coronavirus (SARS-CoV)
	Middle Eastern respiratory syndrome coronavirus (MERS-CoV)
γ -CoV	Avian infectious bronchitis virus (IBV)
	Turkey coronavirus (TCoV)

Note: HCoV-229E, HCoV-OC43, HCoV-NL63, and HKU1 cause only mild upper respiratory disease, SARS-CoV and MERS-CoV can infect lower respiratory tract and cause severe respiratory syndrome in human.

Pathogenesis

1. Angiotensinogen is converted to angiotensin I by renin.
2. Angiotensin I (a decapeptide) is converted by ACE-1 to angiotensin II (an octapeptide).
3. Angiotensin II is an agonist at both angiotensin AT1 and angiotensin AT2 receptors.
4. Angiotensin I is also converted, by ACE-2, to the nonapeptide angiotensin (1-9).
5. Angiotensin II is also converted, by ACE-2, to the heptapeptide angiotensin (1-7).
6. Angiotensin (1-9) is converted, by ACE-1, to angiotensin (1-7).
7. ACE-1 inhibitors inhibit the conversion of angiotensin I to angiotensin II and of angiotensin (1-9) to angiotensin (1-7). Inhibitors of ACE-2 have been developed, but none has been marketed.
8. Angiotensin (1-7) is an antagonist at angiotensin AT1 receptors and an agonist at MAS-1 receptors.
9. Angiotensin receptor antagonists block the actions of angiotensin II and angiotensin (1-7) at angiotensin AT1 receptors.

It is clear from this that the actions of ACE inhibitors and ARBs are complex, and the overall outcomes of using them in the context of COVID-19 are hard to predict.

Figure 2: The renin-angiotensin system and its inhibitors and antagonists

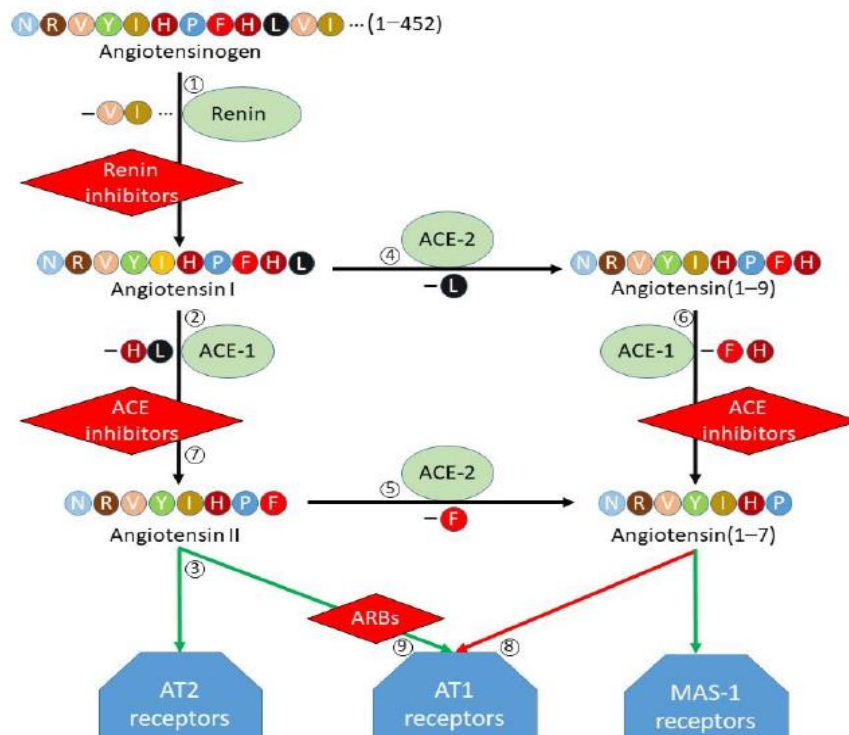
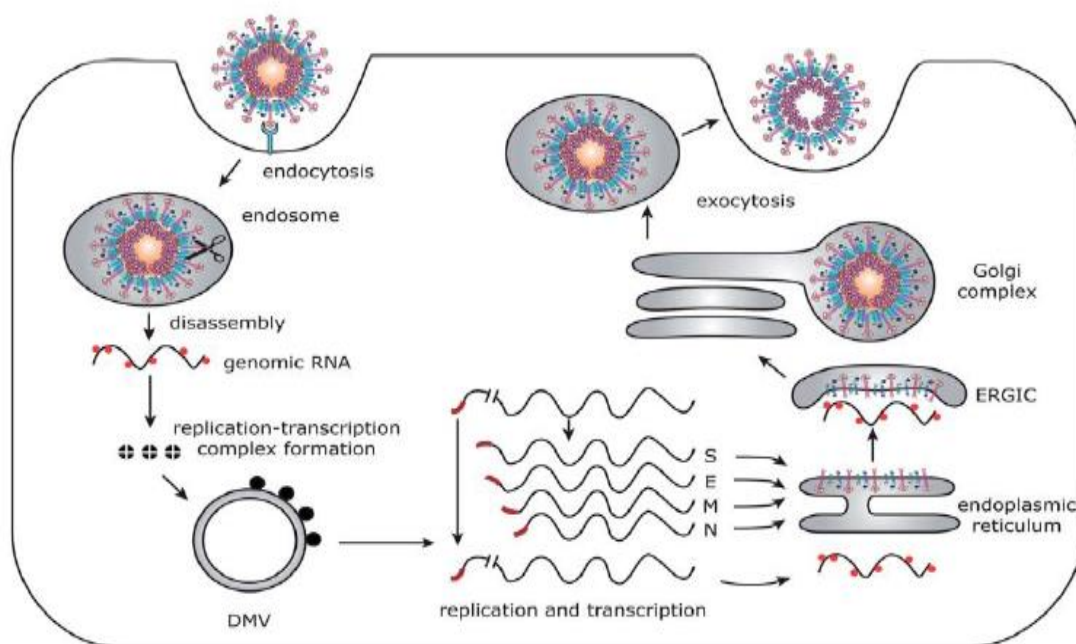
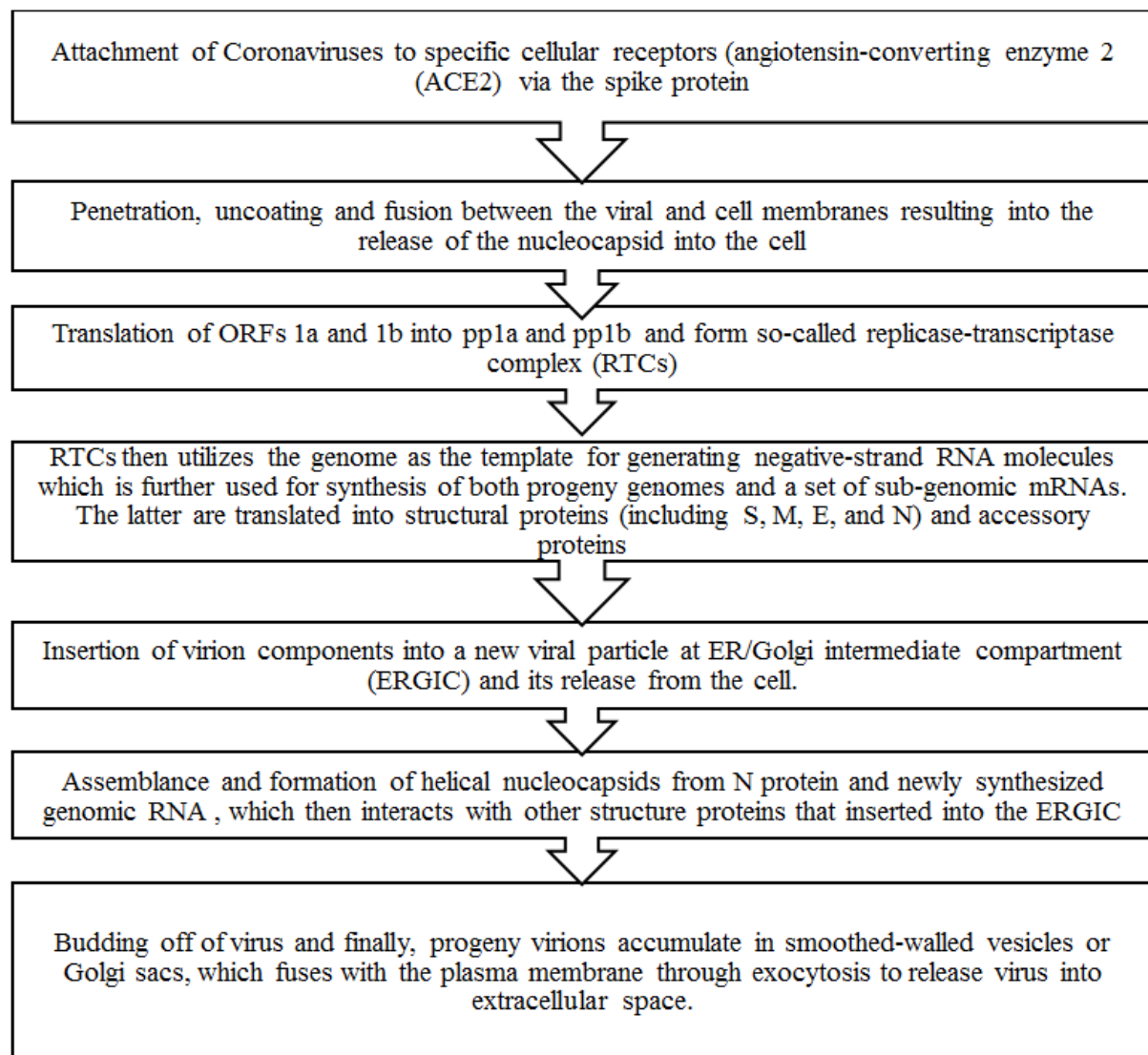


Figure 3: Coronavirus infection cycle





Route of Transmission

In 1962, CoVs in the samples collected from the individuals who present symptoms of respiratory tract infection but presently the first case was found in Wuhan wet market, and later on cases began to be reported after approximately ten days in those patients who had no contact with the marketplace. Human-to-human transmission was confirmed from many infected healthcare workers in Wuhan, China. On January 13, 2020, the first non-Chinese case of the infection, which spread to the Chinese provinces from Thailand and then to the Asian continent. The case reported being a Chinese tourist who has traveled to Thailand and had no epidemiologic connection with the market place. This Human-to-human transmission primarily occurs when an infected person sneezes respiratory droplets produced which can be settled in the mouth or nasal mucosa and lungs of people with inhaled air just as the spread of influenza and other respiratory pathogens. Currently it is considered to be most contagious when people are most symptomatic but can be spread from an asymptomatic person too.

Sign and Symptoms

Fever, sore throat, fatigue, dry cough, aches and pain, headache, shortness of breath, runny or stuffy nose, and diarrhea. On identification refer them for a proper medical check-up and care.

Precautionary Recommendation by UNICEF

1. The viruses do not settle in the air but is grounded, so it is 'not transmitted by air'.
2. When it falls on a metal surface, it will live 12 hours, so 'washing hands with soap' and water well enough.
3. When it falls on the fabric, it remains for 9 hours, so 'washing clothes' or 'being exposed to the sun for two hours meets the purpose of killing it.
4. The virus lives on the hands for 10 mins, so putting an 'alcohol sterilizer' in the pocket meets the purpose of prevention.
5. If the virus is exposed to a temperature of above 30°C, its virulence is significantly reduced, as it fails to multiply in warmer environment. Also drinking hot water and sun exposure will be good.
6. 'Gargle with warm and salt water' kills the tonsils germs and prevents them from leaking into the lungs.

Conclusion

Near future course of COVID-19 has spread almost all over the world barring few, hence its timely diagnosis is essential for quarantine and integrated interventions to control the outbreak. Since there is no effective therapy or vaccine, the best measures now are to control the source of infection, early diagnosis, reporting, isolation, supportive treatments, and timely publishing epidemic information to avoid unnecessary panic. For individuals, good personal hygiene, adapted mask, ventilation, and avoiding crowded places will help to prevent CoVs infection.

References

1. Almeida JD, Berry DM, Cunningham CH, Hamre D, Hofstad MS, Mallucci L et al. Coronaviruses. *Nature*. 1968;220(650):2.
2. Lee C. Porcine epidemic diarrhea virus: an emerging and re-emerging epizootic swine virus. *Virol J*. 2015 Dec 1;12(1):193.
3. Bande F, Arshad SS, Hair Bejo M, Moeini H, Omar AR. Progress and challenges toward the development of vaccines against avian infectious bronchitis. *Journal of immunology research*. 2015;2015.
4. Owusu M, Annan A, Corman VM, Larbi R, Anti P, Drexler JF et al. Human coronaviruses associated with upper respiratory tract infections in three rural areas of Ghana. *PloS one*. 2014;9(7).
5. Van der Hoek L. Human coronaviruses: what do they cause?. *Antiviral therapy*. 2007;12(4 Pt B):651.
6. Vabret A, Mourez T, Gouarin S, Petitjean J, Freymuth F. An outbreak of coronavirus OC43 respiratory infection in Normandy, France. *Clin Infect Dis*. 2003;36(8):985-9.

7. Vabret A, Dina J, Gouarin S, Petitjean J, Tripey V, Brouard J et al. Human (non-severe acute respiratory syndrome) coronavirus infections in hospitalised children in France. *J Paediatr Child Health*. 2008;44(4):176-81.
8. Van Elden LJ, Anton MAM, van Alphen F, Hendriksen KA, Hoepelman AI, van Kraaij MG, et al. Frequent detection of human coronaviruses in clinical specimens from patients with respiratory tract infection by use of a novel real-time reverse-transcriptase polymerase chain reaction. *J Infect Dis*. 2004;189(4):652-7.
9. Yin Y, Wunderink RG. MERS, SARS and other coronaviruses as causes of pneumonia. *Respirology*. 2018;23(2):130-7.
10. Bailey OT, Pappenheimer AM, Cheever FS, Daniels JB. A murine virus (JHM) causing disseminated encephalomyelitis with extensive destruction of myelin: II. Pathology. *J Exp Med*. 1949;90(3):195-212.
11. Cheever FS, Daniels JB, Pappenheimer AM, Bailey OT. A murine virus (JHM) causing disseminated encephalomyelitis with extensive destruction of myelin: I. Isolation and biological properties of the virus. *J Exp Med*. 1949;90(3):181.
12. Yin Y, Wunderink RG. MERS, SARS and other coronaviruses as causes of pneumonia. *Respirology*. 2018;23(2):130-7.
13. Peiris JS, Lai ST, Poon LL, Guan Y, Yam LY, Lim W, Nicholls J et al. Coronavirus as a possible cause of severe acute respiratory syndrome. *The Lancet*. 2003;361(9366):1319-25.
14. Zaki AM, Van Boheemen S, Bestebroer TM, Osterhaus AD, Fouchier RA. Isolation of a novel coronavirus from a man with pneumonia in Saudi Arabia. *N Engl J Med*. 2012;367(19):1814-20.
15. Imai N, Dorigatti I, Cori A, Riley S, Ferguson N. Estimating the potential total number of novel Coronavirus cases in Wuhan City, China. 2020.
16. Lee HJ, Shieh CK, Gorbalenya AE, Koonin EV, La Monica N, Tuler J et al. The complete sequence (22 kilobases) of murine coronavirus gene 1 encoding the putative proteases and RNA polymerase. *Virology*. 1991;180(2):567-82.
17. Lomniczi B. Biological properties of avian coronavirus RNA. *J Gen Virol*. 1977;36(3):531-3.
18. Schoeman D, Fielding BC. Coronavirus envelope protein: current knowledge. *Virol J*. 2019;16(1):69.
19. Hamre D, Procknow JJ. A new virus isolated from the human respiratory tract. *Proceedings of the Society for Experimental Biology and Medicine*. 1966;121(1):190-3.
20. Weiss SR, Navas-Martin S. Coronavirus pathogenesis and the emerging pathogen severe acute respiratory syndrome coronavirus. *Microbiol. Mol. Biol. Rev*. 2005;69(4):635-64.
21. Sahin AR, Erdogan A, Agaoglu PM, Dineri Y, Cakirci AY, Senel ME et al. 2019 Novel Coronavirus (COVID-19) Outbreak: A Review of the Current Literature. *EJMO*. 2020;4(1):1-7.