ORIGINAL RESEARCH PAPER
Volume-9 | Issue-5 | May-2020 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

AWARENESS AND PREVENTIVE MEASURES TO THE THREAT OF COVID 19 INFECTION

Medical Science

Dr. K. Sheela Senior lecturer, Department of Prosthodontics,Dr.M.G.R.Educational &Research Institute,Thai Moogambigai Dental college & Hospital ,Chennai-600037.

Dr. Dhanasekhar Kesavelu* Consultant Pediatrician & Paediatric Gastroenterologist, Apollo Children's Hospital, Chennai. *Corresponding Author

Dr. Rathika Rai Professor, Head of the department, Department of Prosthodontics, Dr.M.G.R. Educational & Research Institute, Thai Moogambigai Dental college & Hospital , Chennai- 600037

ABSTRACT

Coronavirus disease (COVID-19) is an infectious disease caused by a newly discovered coronavirus. It is considered to be a pandemic disease of the year 2019-2020. The pandemic has caused severe global socioeconomic disruption, including the largest global recession and great depression.The virus that causes COVID-19 is mainly transmitted through droplets generated when an infected person coughs, sneezes, or exhales. This article deals with the etiology, pathogenesis, symptoms and preventive measures of coronavirus infection.

KEYWORDS

coronavirus, viral factors, transmission of disease.

INTRODUCTION

According to the World Health Organization (WHO), viral diseases continue to emerge and represent a serious issue to public health. In the past twenty years, several viral epidemics such as the severe acute respiratory syndrome coronavirus (SARS-CoV) in 2002 to 2003, and H1N1 influenza in 2009, have been recorded. Most recently, the Middle East respiratory syndrome coronavirus (MERS-CoV) was first identified in Saudi Arabia in 2012.

In December 2019, a cluster of patients with a novel coronavirus was identified in Wuhan, China[1]. As they were unable to identify the causative agent, the first cases were classified as "pneumonia of unknown etiology." The Chinese Center for Disease Control and Prevention organized an intensive outbreak investigation program and concluded that the source of this illness may be attributed to a novel virus belonging to the coronavirus (CoV) family.

On February 11, 2020, the WHO Director-General, Dr. Tedros Adhanom Ghebreyesus, announced that the disease caused by this new CoV was a "COVID-19," which is the acronym of "Coronavirus Disease 2019". Initially tentatively named 2019 novel coronavirus (2019-nCoV), it has now been named as SARS-CoV-2 by the International Committee of Taxonomy of Viruses (ICTV)[2] as it is very similar to the one that caused the SARS outbreak (SARS-CoVs).

The purpose of this article is to represents a unique tool that may allow the healthcare professionals to make updates in real-time. The aim, therefore, is to collect information and scientific evidence and to provide an overview on the preventive protocol for the patient as well as for healthcare individuals in various fields.

DISCUSSION:

ETIOLOGY:

CoVs are positive-stranded RNA viruses giving a crown-like appearance under an electron microscope (coronam is the Latin term for crown) due to the presence of spike glycoproteins on the envelope. Coronaviruses belong to the family Coronaviridae in the order Nidovirales[3,4]. They can be classified into four genera: Alphacoronavirus, Betacoronavirus, Gammacoronavirus, and Deltacoronavirus. Among them, alpha-and betacoronaviruses infect mammals, gammacoronaviruses infect avian species, and deltacoronaviruses infect both mammalian and avian species. Alphacoronaviruses include human coronavirus NL63 (HCoV-NL63), porcine transmissible gastroenteritis coronavirus (TGEV), porcine epidemic diarrhea coronavirus (PEDV) and porcine respiratory coronavirus (PRCV). Representative beta coronaviruses include SARS-CoV, MERS-CoV, bat coronavirus HKU4, mouse hepatitis coronavirus (MHV), bovine coronavirus (BCoV), and human coronavirus OC43. Representative gamma and delta coronaviruses include avian infectious bronchitis coronavirus (IBV) and porcine delta coronavirus (PdCV), respectively.

In general, estimates suggest that 2% of the population are healthy carriers of a CoV and that these viruses are responsible for about 5% to 10% of acute respiratory infections[5].Other human CoVs: SARS-CoV, SARS-CoV-2, and MERS-CoV (beta CoVs of the B and C lineage, respectively). These cause epidemics with variable clinical severity featuring respiratory and extra-respiratory manifestations. Concerning SARS-CoV, MERS-CoV, the mortality rates are up to 10% and 35%, respectively.

TRANSMISSION:

Several studies suggested that bat may be the potential reservoir of SARS-CoV-2[6,7] . Bats are considered as the natural reservoir of a wide variety of CoVs, including SARS-CoV-like and MERS CoV-like viruses[8,9,10]

In genetic terms, Chan et al. have proven that the genome of the new HCoV, isolated from a cluster-patient with atypical pneumonia after visiting Wuhan, had 89% nucleotide identity with bat SARS-like-CoVZXC21 and 82% with that of human SARS-CoV[11]. For this reason, the new virus was called SARS-CoV-2. It is considered as single-stranded RNA genome containing 29891 nucleotides, encoding for 9860 amino acids. Human-to-human transmission of SARS-CoV-2 occurs mainly between family members, including relatives and friends who intimately contacted with patients or incubation carriers. It is reported that 31.3% of patients recent travelled to Wuhan and 72.3% of patients contacting with people from Wuhan among the patients of nonresidents of Wuhan[12]. Transmission between healthcare workers occurred in 3.8% of COVID-19 patients, issued by the National Health Commission of China on 14 February 2020. By contrast, the transmission of SARS-CoV and MERS-CoV is reported to occur mainly through nosocomial transmission. Infections of healthcare workers in 33–42% of SARS cases and transmission between patients (62–79%) was the most common route of infection in MERS-CoV cases[13,14]. Direct contact with intermediate host animals or consumption of wild animals was suspected to be the main route of SARS-CoV-2 transmission.

GENOME STRUCTURE AND VIRAL FACTORS

Isolated from a COVID-19 pneumonia patient, a worker in the Wuhan seafood market, the complete genome of Wuhan-Hu-1 coronavirus (WHCV), one strain of SARSCoV-2, is 29.9 kb[15]. While SARS-CoV and MERS-CoV have positive-sense RNA genomes of 27.9 kb and 30.1 kb,respectively[16].SARS-CoV-2 may originate from bats or unknown intermediate hosts and cross the species barrier into humans. Virus-host interactions affect viral entry and replication SARS-CoV-2 is an enveloped positive single-stranded RNA (ssRNA) coronavirus. It has been shown that the genome of CoVs contains a variable number (6–11) of open reading frames (ORFs)[17].Two-thirds of viral RNA, mainly located in the first open reading frame (ORF 1a/b) translates two polyproteins, pp1a and pp1ab , encodes 16 non-structure proteins

(NSPs). The rest part of the virus genome encodes four essential structural proteins, including spike (S) glycoprotein, small envelope (E) protein, matrix (M) protein, and nucleocapsid (N) protein[18], and also several accessory proteins. S glycoprotein of SARS-CoV-2 binds to host cell receptors, angiotensin-converting enzyme 2 (ACE2),

that is a critical step for virus entry. Other virus proteins may contribute to pathogenesis.

PATHOGENESIS:

ACE2, found in the lower respiratory tract of humans, is known as cell receptor for SARS-CoV and regulates both the cross-species and human-to-human transmission and symptomatic people are the most frequent source of COVID-19 spread[19,20]. The other respiratory pathogens, including flu and rhinovirus, the transmission is believed to occur through respiratory droplets from coughing and sneezing. Aerosol transmission is also possible in case of exposure to elevated aerosol concentrations in closed spaces..

The virion S-glycoprotein on the surface of coronavirus can attach to the receptor, ACE2 on the surface of human cells[21]. S glycoprotein includes two subunits, S1 and S2[22]. S1 determines the virus-host range and cellular tropism with the key function domain – RBD(Receptor Binding Protein), while S2 mediates virus-cell membrane fusion by two tandem domains, heptad repeats 1 (HR1) and HR2[23]. After membrane fusion, the viral genome RNA is released into the cytoplasm, and the uncoated RNA translates two polyproteins, pp1a and pp1ab[24], which encode non-structural proteins, and form replication-transcription complex (RTC) in double-membrane vesicle[25]. Continuously RTC replicate and synthesize a nested set of subgenomic RNAs , which encode accessory proteins and structural proteins. Mediating endoplasmic reticulum (ER) and Golgi , newly formed genomic RNA, nucleocapsid proteins and envelope glycoproteins assemble and form viral particle buds. Lastly, the virion-containing vesicles fuse with the plasma membrane to release the virus.

The data so far available seem to indicate that the viral infection is capable of producing an excessive immune reaction in the host. In some cases, a reaction takes place which as a whole is labeled a 'cytokine storm'. The effect is extensive tissue damage. The protagonist of this storm is interleukin 6 (IL-6). IL-6 is produced by activated leukocytes and acts on a large number of cells and tissues. It is able to promote the differentiation of B lymphocytes, promotes the growth of some categories of cells, and inhibits the growth of others. It also stimulates the production of acute phase proteins and plays an important role in thermoregulation, in bone maintenance and in the functionality of the central nervous system. Although the main role played by IL-6 is pro-inflammatory, it can also have anti-inflammatory effects. In turn, IL-6 increases during inflammatory diseases, infections, autoimmune disorders, cardiovascular diseases and some types of cancer. It is also implicated into the pathogenesis of the cytokine release syndrome (CRS) that is an acute systemic inflammatory syndrome characterized by fever and multiple organ dysfunction.

SYMPTOMS AND PROGRESSION OF DISEASE:

The dominant clinical features of COVID-19 were fever, cough, and fatigue, while congestion, rhinorrhea, sore throat and diarrhea are rare[26-29]. The most frequently reported laboratory abnormalities were reduced lymphocyte count, elevated C-reactive protein, and elevated lactate dehydrogenase, all of which are generally consistent with previous reports of patients with COVID-19.

The studies done by Huang et al[30] and Chen et al indicate that the main clinical manifestations of COVID-19 are fever (90% or more), cough (around 75%), and dyspnea (up to 50%). myalgia or fatigue (44%), sputum production (28%), headache (8%), hemoptysis (5%), and diarrhea (3%).A small but significant subset has gastrointestinal symptoms cases with SARS-CoV-2–infected pneumonia were also reported by Chen et al which revealed that older males with weaker immune function were the most susceptible to COVID-19 incidence.

Chinese CDC report divided the clinical manifestations of the disease based on there severity. Mild disease are categorized under symptoms of non-pneumonia and mild pneumonia which was evident in 81% of cases.Severe disease having the symptoms of dyspnea, respiratory frequency ≥ 30/min, blood oxygen saturation (SpO2) ≤ 93%, PaO2/FiO2 ratio or P/F [the ratio between the blood pressure of the oxygen (partial pressure of oxygen, PaO2) and the percentage of oxygen supplied (fraction of inspired oxygen, FiO2)] < 300, and/or lung infiltrates > 50% within 24 to 48 hours which occurred in 14% of cases.Critical disease are cases of respiratory failure, septic shock, and/or multiple organ dysfunction (MOD) or failure (MOF) which occurred in 5% of cases[31]

LABORATORY ALGORITHM:

It is necessary that all the patient should undergo laboratory investigation as most of the symptoms of covid 19 are similar to common cold/seasonal flu and sometimes its asymptomatic also.Routine confirmation of cases of COVID-19 is based on detection of unique sequences of virus RNA by NAAT such as real-time reverse transcription polymerase chain reaction (rRT-PCR) .Laboratory investigations can be done in two pathways such as detection of coronavirus itself and the detection of body's adaptive immune response to the virus. The confirmation is made through real time RT polymerase chain reaction(Rrt-PCR).detection of SARS-CoV-2 virus(the virus that cause COVID 19) in either upper respiratory specimens(nasopharyngeal or oropharyngeal swabs)/lower respiratory mechanism(sputum if produced, endotracheal aspirate, bronchoalveolar lavage) in patients with more respiratory diseases. The viral genes targeted so far include the N, E, S and RdRP[32] genes. Laboratory algorithm is represented in flow chart(Figure-1)

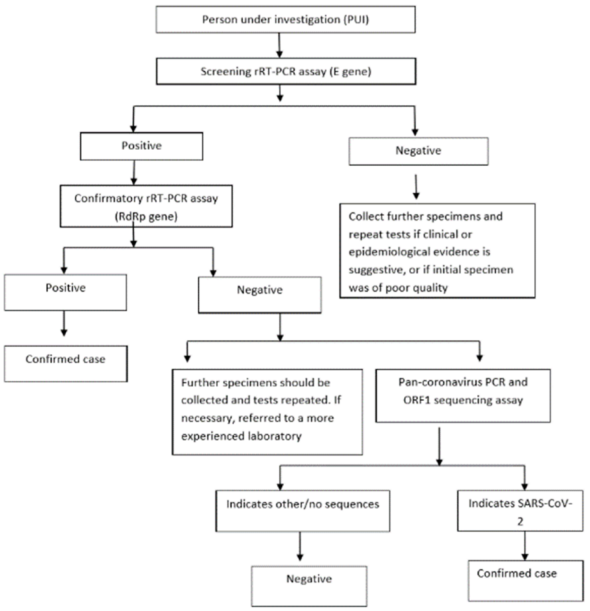

Figure 1: Laboratory Algorithm

PREVENTIVE MEASURES:

Preventive strategies are focused on the isolation of patients and careful infection control, including appropriate measures to be adopted during the diagnosis and the provision of clinical care to an infected patient. Social distancing and self isolation are recommended by world health organisation.The most important strategy to undertake is to frequently wash the hands and use portable hand sanitizer and avoid contact with the face and mouth after interacting with a possibly contaminated environment.

Healthcare workers caring for infected individuals should utilize contact and airborne precautions to include personal protective equipments (PPE)such as N95 or FFP3 masks, eye protection, gowns, and gloves to prevent transmission of the pathogen.

Patients and families should receive instruction to avoid close contact with subjects suffering from acute respiratory infections. People with symptoms of acute airway infection should keep their distance, cover coughs or sneezes with disposable tissues or clothes and wash their hands. Immunocompromised patients should avoid public exposure and public gatherings. If an immunocompromised individual must be in a closed space with multiple individuals present, such as a meeting in a small room; masks, gloves, and personal hygiene with antiseptic soap should be undertaken by those in close contact with the individual. In addition, prior room cleaning with antiseptic agents should be undertaken and performed before exposure.

TREATMENT:

No specific antiviral treatment are recommended for COVID-19, and vaccines are also currently not discovered. The treatment is symptomatic, and oxygen therapy represents the major treatment intervention for patients with severe infection. Mechanical ventilation may be necessary in cases of respiratory failure refractory to oxygen therapy, whereas hemodynamic support is essential for managing septic shock.

On January 28, 2020, the WHO released a document summarizing WHO guidelines and scientific evidence derived from the treatment of previous epidemics from HCoVs. Among these recommendations respiratory failure are treated with protective mechanical ventilation and high-flow nasal oxygen (HFNO).

Although no antiviral treatments have been approved, several approaches have been proposed such as lopinavir/ritonavir (400/100 mg every 12 hours), chloroquine (500 mg every 12 hours), and hydroxychloroquine (200 mg every 12 hours). Alpha-interferon (e.g., 5 million units by aerosol inhalation twice per day) is also used. Many research on reverse vaccinology were also going on to put an end to this pandemic situation.

CONCLUSION:

Data provided by the WHO Health Emergency Dashboard reported 142.320 confirmed cases worldwide since the beginning of the epidemic. 5.388 (3.78%) cases have been fatal. Many steps like contact tracing and containment of the affected area were also implemented and carried out by government to prevent the spread of coronavirus infection. However potential need for investigations on organ damage in infected patients should also be considered .

ACKNOWLEDGEMENT: None
FUNDING: None
CONFLICT OF INTEREST: None

REFERENCES:

1. Zhu N, Zhang D, Wang W, Li X, Yang B, Song J, Zhao X, Huang B, Shi W, Lu R, Niu P. A novel coronavirus from patients with pneumonia in China, 2019. New England Journal of Medicine. 2020 Jan 24.
2. Gorbalenya AE. Severe acute respiratory syndrome-related coronavirus–The species and its viruses, a statement of the Coronavirus Study Group. BioRxiv. 2020 Jan 1.
3. Enjuanes L, Almazán F, Sola I, Zuñiga S. Biochemical aspects of coronavirus replication and virus-host interaction. Annu. Rev. Microbiol.. 2006 Oct 13;60:211-30.
4. Perlman S, Netland J. Coronaviruses post-SARS: update on replication and pathogenesis. Nature reviews microbiology. 2009 Jun;7(6):439-50.
5. Chen Y, Liu Q, Guo D. Emerging coronaviruses: genome structure, replication, and pathogenesis. Journal of medical virology. 2020 Apr;92(4):418-23.
6. Giovanetti M, Benvenuto D, Angeletti S, Ciccozzi M. The first two cases of 2019.nCoV in Italy: Where they come from?. Journal of Medical Virology. 2020 Feb 5.
7. 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. Infection, Genetics and Evolution. 2020 Apr 1;79:104212.
8. Hampton T. Bats may be SARS reservoir. Jama. 2005 Nov 9;294(18):2291.
9. Banerjee A, Kulcsar K, Misra V, Frieman M, Mossman K. Bats and coronaviruses. Viruses. 2019 Jan;11(1):41.
10. Li W, Shi Z, Yu M, Ren W, Smith C, Epstein JH, Wang H, Crameri G, Hu Z, Zhang H, Zhang J. Bats are natural reservoirs of SARS-like coronaviruses. Science. 2005 Oct 28;310(5748):676-9.
11. Chan JF, Kok KH, Zhu Z, Chu H, To KK, Yuan S, Yuen KY. Genomic characterization of the 2019 novel human-pathogenic coronavirus isolated from a patient with atypical pneumonia after visiting Wuhan. Emerging Microbes & Infections. 2020 Jan 1;9(1):221-36.
12. Guan WJ, Ni ZY, Hu Y, Liang WH, Ou CQ, He JX, Liu L, Shan H, Lei CL, Hui DS, Du B. Clinical characteristics of coronavirus disease 2019 in China. New England Journal of Medicine. 2020 Feb 28.
13. Chowell G, Abdirizak F, Lee S, Lee J, Jung E, Nishiura H, Viboud C. Transmission characteristics of MERS and SARS in the healthcare setting: a comparative study. BMC medicine. 2015 Dec;13(1):210.
14. Kang CK, Song KH, Choe PG, Park WB, Bang JH, Kim ES, Park SW, Kim HB, Kim NJ, Cho SI, Lee JK. Clinical and epidemiologic characteristics of spreaders of Middle East respiratory syndrome coronavirus during the 2015 outbreak in Korea. Journal of Korean medical science. 2017 May 1;32(5):744-9.
15. Wu F, Zhao S, Yu B. A new coronavirus associated with human respiratory disease in China.[published on February 03, 2020]. Nature.
16. De Wit E, van Doremalen N, Falzarano D, Munster VJ. SARS and MERS: recent insights into emerging coronaviruses. Nature Reviews Microbiology. 2016 Aug;14(8):523.
17. Song Z, Xu Y, Bao L, Zhang L, Yu P, Qu Y, Zhu H, Zhao W, Han Y, Qin C. From SARS to MERS, thrusting coronaviruses into the spotlight. Viruses. 2019 Jan;11(1):59.
18. Cui J, Li F, Shi ZL. Origin and evolution of pathogenic coronaviruses. Nature reviews Microbiology. 2019 Mar;17(3):181-92.
19. Jia HP, Look DC, Shi L, Hickey M, Pewe L, Netland J, Farzan M, Wohlford-Lenane C, Perlman S, McCray PB. ACE2 receptor expression and severe acute respiratory syndrome coronavirus infection depend on differentiation of human airway epithelia. Journal of virology. 2005 Dec 15;79(23):14614-21.
20. Wan Y, Shang J, Graham R, Baric RS, Li F. Receptor recognition by the novel coronavirus from Wuhan: an analysis based on decade-long structural studies of SARS coronavirus. Journal of virology. 2020 Mar 17;94(7).
21. Tortorici MA, Veesler D. Structural insights into coronavirus entry. Advances in virus research. 2019 Aug 22;105:93-116.
22. Zhang N, Jiang S, Du L. Current advancements and potential strategies in the development of MERS-CoV vaccines. Expert review of vaccines. 2014 Jun 1;13(6):761-74.
23. Xia S, Zhu Y, Liu M, Lan Q, Xu W, Wu Y, Ying T, Liu S, Shi Z, Jiang S, Lu L. Fusion mechanism of 2019-nCoV and fusion inhibitors targeting HR1 domain in spike protein. Cellular & Molecular Immunology. 2020 Feb 11:1-3.
24. de Wilde AH, Snijder EJ, Kikkert M, van Hemert MJ. Host factors in coronavirus replication. InRoles of Host Gene and Non-coding RNA Expression in Virus Infection 2017 (pp. 1-42). Springer, Cham.
25. Sawicki SG, Sawicki DL. Coronavirus transcription: a perspective. InCoronavirus replication and reverse genetics 2005 (pp. 31-55). Springer, Berlin, Heidelberg.
26. Guan WJ, Ni ZY, Hu Y, Liang WH, Ou CQ, He JX, Liu L, Shan H, Lei CL, Hui DS, Du B. Clinical characteristics of coronavirus disease 2019 in China. New England Journal of Medicine. 2020 Feb 28.
27. Li Q, Guan X, Wu P, Wang X, Zhou L, Tong Y, Ren R, Leung KS, Lau EH, Wong JY, Xing X. Early transmission dynamics in Wuhan, China, of novel coronavirus–infected pneumonia. New England Journal of Medicine. 2020 Jan 29.
28. Chen N, Zhou M, Dong X, Qu J, Gong F, Han Y, Qiu Y, Wang J, Liu Y, Wei Y, Yu T. Epidemiological and clinical characteristics of 99 cases of 2019 novel coronavirus pneumonia in Wuhan, China: a descriptive study. The Lancet. 2020 Feb 15;395(10223):507-13.
29. Xu XW, Wu XX, Jiang XG, Xu KJ, Ying LJ, Ma CL, Li SB, Wang HY, Zhang S, Gao HN, Sheng JF. Clinical findings in a group of patients infected with the 2019 novel coronavirus (SARS-Cov-2) outside of Wuhan, China: retrospective case series. Bmj. 2020 Feb 19;368.
30. Huang C, Wang Y, Li X, Ren L, Zhao J, Hu Y, Zhang L, Fan G, Xu J, Gu X, Cheng Z. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. The Lancet. 2020 Feb 15;395(10223):497-506.
31. Wu Z, McGoogan JM. Characteristics of and important lessons from the coronavirus disease 2019 (COVID-19) outbreak in China: summary of a report of 72 314 cases from the Chinese Center for Disease Control and Prevention. Jama. 2020 Feb 24.
32. laboratory testing for coronavirus 2019(COVID 19) in suspected human cases: interim guidance,2March 2020- http: //apps.who.int/ iris/handle/10665/331329-accessed 25.3.2020