



2019 NOVEL CORONAVIRUS (SARS-CoV-2) - A BRIEF REVIEW

Pathology

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ABSTRACT

The term coronavirus derives from its electron microscopic image, which resembles a crown – or corona. Coronavirus (CoV) are a large family of enveloped, non-segmented, single-stranded RNA virus with a high mutation rate. In this review, I have briefly discussed general overview of coronavirus and describe the epidemiology, pathogenesis, mode of transmission, clinical features, radiological & histological findings, diagnosis, preventive measures and treatment modalities about the disease.

KEYWORDS

Coronavirus, diagnosis, pathogenesis.

INTRODUCTION

Coronavirus become an important pathogen due to its widespread occurrence and infectivity. Coronavirus (CoV) is pleomorphic, single-stranded RNA virus (viral RNA genome ranges from 26 to 32 kilobases in length)⁽¹⁾. Constantly developing transcription errors and RNA Dependent RNA Polymerase (RdRP) jumps, cause a very high recombination rates of CoVs⁽²⁾. Coronaviruses are zoonotic pathogens (from animal to human) that can be isolated from birds, livestock, camels, bats, masked palm civets, mice, dogs, and cats. Humans are infected by six strains of coronavirus⁽³⁾. They exhibit a wide range of clinical features ranging from asymptomatic course to Severe Acute Respiratory Syndrome (SARS).

In 2003 SARS-CoV started in Guangdong, China and spread to southeast Asia, North America, Europe, and South Africa. Bats are the natural hosts and palm civets and raccoon dogs are intermediate hosts of SARS-CoV. Although in early cases transmission occurred through human and animal contact but later it was found that transmission occurred person-to-person through droplets produced by coughing or sneezing, personal contact, touching contaminated surfaces. The last reported case of SARS-CoV was in September 2003⁽⁴⁾. A group of patients with pneumonia of unknown etiology was observed in Wuhan on December 30, 2019 and a new coronavirus (SARS-CoV-2) was isolated from these patients on January 7, 2020. Initially, this virus was designated as “novel coronavirus 2019” (2019-nCoV) by the WHO but, International Committee on Taxonomy of Viruses designated it as the SARS-CoV-2 virus on February 11, 2020⁽⁵⁾.

Herein epidemiology, pathogenesis, clinical features, diagnosis, preventive measures and treatment modalities of novel corona virus are briefly discussed.

EPIDEMIOLOGY

On January 22, 2020, it was noted that novel CoV was originated from wild bats and belonged to Group 2 of beta-coronavirus that causes Severe Acute Respiratory Syndrome (SARS-CoV). Both COVID-19 and SARS-CoV belong to the same beta coronavirus subgroup with 70% genomic similarity⁽⁶⁾.

Hassan et al. depicted the analogy of epidemiological characteristics of SARS-CoV-2 and SARS-CoV as follows⁽⁷⁾:

Table 1: Comparison Of Epidemiological Characteristics⁽⁷⁾

Features	SARS- CoV-2	SARS-CoV
Approximated R0	2.68	2-5
Virus host	Natural: Bats Intermediate: Pangolins Terminal: Humans	Natural: Chinese horseshoe bats Intermediate: Masked palm civets Terminal: Humans
Mode of transmission	Nosocomial, zoonotic, human-to human through fomites, aerosol droplet, physical contact	Nosocomial, zoonotic, human-to human through aerosol droplet, opportunistic airborne, faecal-oral
Incubation period	6.4 days	4.6 days

PATHOGENESIS

There are four proteins (spike, envelope, nucleotides) in the virion. One-third of the genome has genes for four structural proteins and eight genes for accessory proteins that jeopardise host defences. Spike protein (densely glycosylated) of SARS-CoV-2 virions bind with high affinity to the angiotensin-converting enzyme 2 receptor on human alveolar type II cells. The TMPRSS2 protease cleaves the spike protein and it makes virions to release their RNA into infected cells. Thus, infected cells can produce 100 to 1,000 virions per day by replication and translation of viral RNA into new viral proteins⁽⁴⁾. Virions are released from the infected cell through exocytosis and infect kidney cells, liver cells, intestines, and T lymphocytes, as well as the lower respiratory tract⁽⁸⁾.

MODE OF TRANSMISSION

Advanced virological and genetic studies have shown that animals act as intermediate hosts of SARS-CoV before these viruses spread to humans. It was also found that source of alpha-CoV and beta-CoVs gene was most of the bat CoVs while most of the bird CoVs are the gene source of gamma-CoVs and delta-CoVs⁽⁹⁾. Human-to-human transmission occurs with close contact or through the respiratory droplets when an infected person sneezes. Through inhaled air, these droplets can settle in the mouth or nasal mucosa and lungs of people. It is very contagious during asymptomatic phase of infected person. Initial rapid spread of the virus in Wuhan occur mainly due to a large population of 11 million increasing the chance of person-to person contact. The incubation period was previously thought from 1 to 14 days with a median of five to six days, but recently reports suggest that it may be 24 days⁽⁴⁾.

CLINICAL FEATURES

Clinical features vary from simple respiratory infection to septic shock⁽²⁾. Fever, dry cough, fatigue, myalgia, and shortness of breath are common symptoms. Pneumonia can be developed towards the end of the first week of infection. The mean interval is between 9.1 and 12.5 days from onset of illness to hospitalization. Approximately 25 percent of patients require intensive care, and approximately 10 percent require mechanical ventilation⁽⁴⁾.

Pneumonia and acute respiratory distress syndrome are severe signs. Children and younger adults have less severe sign but they can act as asymptomatic carrier. Diarrhoea was observed in about 20-25% of patients with SARS-CoV infection. Chest pain, confusion, and nausea-vomiting, symptoms of expectoration, headache, hemoptysis were also noted^(10,11). Bilateral lung involvement along with viral pneumonia was seen mostly in patient with comorbidities (diabetes mellitus, hypertension, and cardiovascular disease)⁽²⁾. COVID-19 cases have an estimated doubling time of 6 days. Fatality rate is 2% to 4% but it is higher in older individuals⁽⁴⁾.

RADIOLOGICAL & HISTOLOGICAL FINDINGS

Chest X-rays or thorax CT imaging may reveal unilateral or bilateral involvement along with viral pneumonia and bilateral multiple lobular and subsegmental consolidation areas were also observed in severely infected patients^(11,12). Complications include ARDS, acute heart damage, secondary infections, dyspnea, pneumothorax⁽²⁾. Chest radiographs are abnormal in 60 percent of cases (77 percent if severe).

Chest CT is abnormal in 86 percent of cases (95 percent if severe)⁽⁴⁾.

One histopathological study of the lungs of a deceased patient revealed the presence of hyaline membrane formation, interstitial mononuclear inflammatory infiltrates, and multinucleated giant cells which were corroborative to the findings of acute respiratory distress syndrome⁽⁴⁾.

DIAGNOSIS

Laboratory findings revealed lymphopenia (70%), prolonged prothrombin time (58%), elevated lactate dehydrogenase (40%), elevated AST and ALT (4–22%), increased CRP (61–86%)⁽⁴⁾.

The diagnostic tools include molecular methods, serology and viral culture. RT-PCR (reverse transcription) or real-time PCR is a common molecular method to detect viral RNA from respiratory samples such as oropharyngeal swabs, sputum, nasopharyngeal aspirate, deep tracheal aspirate, or bronchoalveolar lavage. Lower respiratory tract samples have significantly higher viral load and genome fraction than upper respiratory tract samples to evaluate quickly the genome structure and viral load⁽¹²⁾.

Antibody detection generally has lower sensitivity than molecular methods. Viral culture is a time consuming method and it useful only in the first stage of outbreaks before other diagnostic methods become clinically available. It can be also used for the in-vitro and in-vivo antiviral treatment and vaccine evaluation trials⁽⁹⁾.

PREVENTIVE MEASURES

Quarantine measures and mitigation can reduce human to human transmission by travel limitations and social distancing. Mitigation includes handwashing along with focuses on protecting the most vulnerable from the widespread community. Reduction in the number of active cases gives the health care professionals to provide better response⁽⁴⁾.

TREATMENT MODALITIES

There is no vaccine or effective treatment to prevent COVID-19 infection till now. Treatment modalities are primarily supportive care and oxygen supplementation when needed. Remdesivir (inhibits the transcription of many RNA viruses), lopinavir/ritonavir (mixture of two HIV protease inhibitors), favilavir (interferes with the function of the nonstructural proteins to make new RNA molecules), Chloroquine (may interfere with virus entry into cells) are showing few positive results against SARS-CoV-2^(4,13). The Centers for Disease Control and Prevention (CDC) recommend health care professionals to use personal protective equipment (wear a gown, gloves, and either an N95 respirator plus a face shield or goggles or a powered, air-purifying respirator), hand washing, disinfectant solutions. It is also advisable to avoid direct contact with patients in order to prevent the spread of virus by droplets⁽¹³⁾.

CONCLUSION

We still have to know more about covid-19 pandemic which is spreading the entire globe in an alarming condition. Elderly and patients with co morbidities are at the greatest risk of fatality. Rapid diagnosis and isolation protocols are must to prevent further transmission. Current treatment modalities are only symptomatic care and oxygen therapy as there is no confirmed medication or vaccine. Prophylactic vaccination is the utmost requirement along with every preventative measures. This review briefly summarizes the epidemiology, pathogenesis, mode of transmission, clinical features, radiological & histological findings, diagnosis, preventive measures and treatment modalities of covid 19 pandemic.

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