

Comparison between Coronavirus Diseases (COVID-19, SARS, and MERS)

Telly Kamelia and Zulkifli Amin*

Respirology and Critical Illness Division, Department of Internal Medicine, Faculty of Medicine, Universitas Indonesia, Cipto Mangunkusumo National General Hospital, Indonesia

***Corresponding Author:** Zulkifli Amin, Respirology and Critical Illness Division, Department of Internal Medicine, Faculty of Medicine, Universitas Indonesia, Cipto Mangunkusumo National General Hospital, Indonesia.

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Abstract

Human coronaviruses (HCoVs) have been identified as pathogen that cause outbreaks since the last two decades which known as severe acute respiratory syndrome (SARS) in 2002 and Middle East respiratory syndrome (MERS) in 2012. Both coronavirus diseases came up with respiratory symptoms and some of the cases sometimes present with gastrointestinal symptoms. A new HCoV caused a major disease outbreak was found after being isolated from the respiratory epithelium of unknown pneumonia patients that linked to Huanan Seafood Market in Wuhan City, Hubei Province, China in December 2019 and this virus has been named as severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) while the disease called as coronavirus disease 2019 (COVID-19). As we study, this coronavirus have some similarities as well as differences to the other HCoVs. The symptoms worsening that occur is racing against a wider spread of the disease. And if the new case confirmed and treated as early as possible, complication of the disease are much more preven-table along with reducing the mortality rate.

Keywords: Coronaviruses; SARS-CoV-2; COVID-19; SARS-CoV; MERS-CoV; Clinical Manifestations; Genomic Comparison

Introduction

Coronavirus, a group of viruses that can be found in humans, can cause several symptoms starting from mild respiratory symptoms, gastrointestinal and some of them can evolve into serious conditions and much worse could be a life-threatening conditions that could strike from children to adults. Coronavirus can spread through animals (zoonosis) and indirectly it's causing a global pandemic in the last two decades by the name we know as SARS-CoV and MERS-CoV [1,2]. In the late December 2019, a new case of novel coronavirus presented as an unknown pneumonia was discovered in China and the World Health Organization (WHO) used the term of COVID-19 (CoronaVirus Disease 2019), for naming the disease as per February 11th 2020 [2,3]. The Covid-19 was first appeared in December 2019, with patients that linked to Huanan Seafood and Wet Animal Wholesale Market in Wuhan, Hubei Province, South China. Suspected patients of Covid-19 that exhibited symptoms of viral respiratory infection including fever, difficulty of breathing, and infiltration in the lungs, took a nasopharyngeal and oropharyngeal swab to be tested under the microscope using an RT-PCR to identify the causal of the disease [4,5]. WHO Situational Report on Coronavirus disease 2019 (Covid-19) as per 20 February 2020 stated that there are 75,748 confirmed cases globally, with 74,675 confirmed cases and 2121 deaths in China with 1073 confirmed cases and 8 deaths in 26 different countries [6].

History of Covid-19

Covid-19 (short for Coronavirus disease-2019) is one of the infectious respiratory disease that caused by a coronavirus, a group of RNA virus who had a shape like a "crown". This virus is known to have not only respiratory symptoms but also affects the gastrointestinal, liver

and nervous system. Generally, there were four viruses that cause flu and cough, they are 229E, OC43, NL63 and HKU11, and the other two types of viruses that we all know are the main causes of a global pandemic in the last two decades were SARS-CoV and MERS-CoV. Covid-19 itself was first known in the late December 2019, after several patients with unknown pneumonia were discovered that linked to one and another with Huanan Seafood and Wet Animal Wholesale Market in Wuhan. At first, there were three cases of adult patient that been admitted to a hospital in Wuhan who presented severe pneumonia. They were a retailer and frequent visitors to the seafood market. In early January 2020, 2 patients were recovered and discharged from the hospital on January 16, 2020, while 1 patient died because of respiratory distress earlier on January 9, 2020. At that time there was no biopsy specimen that been collected, but their bronchoalveolar-lavage samples were taken from them. The hospital laboratory found out that the genetic sequence was matched with the novel coronavirus and betacoronavirus group which 85% match to bat SARS-like CoV [5,7,8].

After Covid-19 become an outbreak in China in early 2020, several cases outside the country were discovered. The nearest region with a laboratory-confirmed case was found in Thailand, Japan and Korea and the first case in United State was found on January 19, 2020. All cases found had a travel history to Wuhan. A secondary source of infection of this disease was found to be a human-to-human transmission. The first case found was from a taxi driver in Thailand who get infected by Chinese tourist passenger who was coughing, the passenger was wearing a mask and the taxi driver had no travel history to Wuhan. Since January 1, 2020, the Huanan Seafood Wholesale Market in Wuhan was closed for environmental sanitation and disinfection and market inspection expand to other markets, and as of January 23, 2020, Hubei Province was lockdown until today. These efforts made by the government aim to reduce the spread of the viruses from human-to-human and nevertheless spread through airborne transmission, and this possible source of transmission could indicate a potential outbreak of the virus to spread rapidly [7,9].

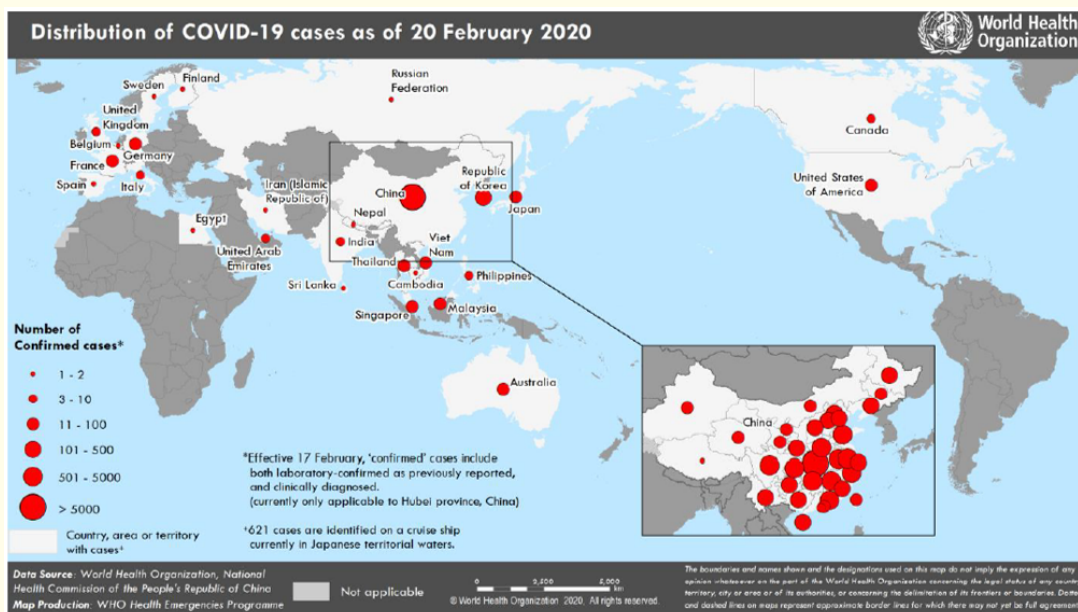


Figure 1: Distribution of Covid-19 cases as of 20 February 2020 from WHO Situation Report [6].

Genome sequence between coronaviruses

Coronaviruses are included in the subfamily *Coronavirinae* in the family of *Coronaviridae* of the order *Nidovirales* and this group of viruses has four genera subfamily: *Alphacoronavirus*, *Betaoronavirus*, *Gammacoronavirus* and *Deltacoronavirus*. Coronaviruses genome is

single-stranded positive-sense RNA with 5'-cap structure and 3'-poly-A tail. The CoVs genome size is the largest among all RNA viruses [10]. PCR products presented a phylogenetic analysis, which was taken from a family who believed have been infected by the novel coronavirus, showing that both RdRp and S genes of Covid-19 were a span-new structure that different from other coronaviruses that can be found in human or animal, but from sequence analysis showed it has a typical genome structure of coronavirus and belongs to the cluster of beta coronaviruses that includes Bat-SARS-like (SL)-ZC45, Bat-SL ZXC21, SARS-CoV and MERS-CoV. Based on the phylogenetic tree of CoVs, Covid-19 virus is more closely related to bat-SL-CoV ZC45 and bat-SL-CoV ZXC21 and more distantly related to SARS-CoV [10-12].

Dr. Zhang's research group from Fudan University and several groups in China were working on a rapid sequence for nearly 30,000 nucleotides from the genome-Covid-19. The sequence of Covid-19 virus complete genome has reported takes less than one month to be discovered by China CDC, in contrasted compared to the discovery of SARS-CoV and MERS-CoV [13]. After sequencing has been done it showed that the complete genome of this novel coronavirus nucleotide chains is most closely related to the bat SARS-like coronavirus bat-SL-CoVZXC21 and bat-SL-CoVZC45, while their genome organization is typical of a lineage B beta coronavirus that referred as Group 2B, which has a different chain of SARS-CoV. From the entire genome assessment, Covid-19 is known to contain ~66% of amino acid sequence of the N-terminal domain of spike subunit 1 and ~ 68% amino acid sequence of the core domain of the receptor binding identity of nucleotides from the original epidemic virus of SARS, while the external subdomain region protein of receptor-binding domain of Spike subunit 1 has only 39% identity, which affects the human receptor and its biological behaviour [12,13].

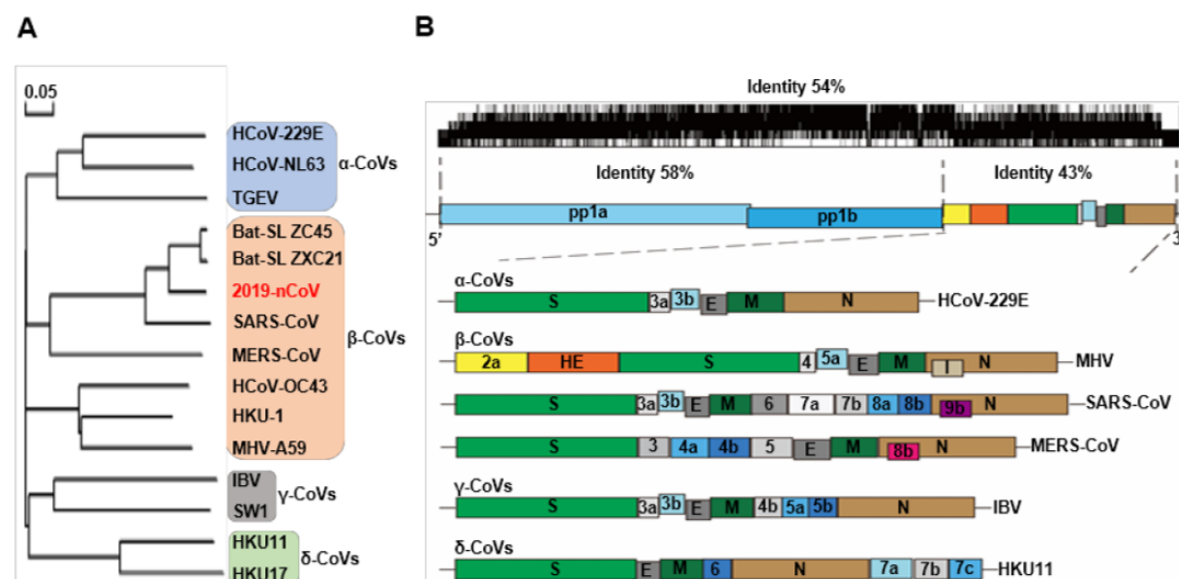


Figure 2: (a) The phylogenetic tree of representative CoVs. (b) The genome structure of four genera of coronaviruses [10].

Clinical features and laboratory of coronaviruses

Covid-19 and previous betacoronavirus infections showed some similarities of their clinical features that most patients presented with fever, dry cough, dyspnea, and bilateral ground-glass opacities on chest CT scans. Few patients with Covid-19 had prominent upper respiratory tract signs and symptoms (e.g. rhinorrhea, sneezing, or sore throat), which point out that the infection target cells might be located in the lower airway. Covid-19 patients are known to rarely develop intestinal signs and symptoms (e.g. diarrhea), though about

20 - 25% of patients with MERS-CoV or SARS-CoV infection had diarrhea. Fecal and urine samples should be tested to exclude a potential alternative route of transmission that is unknown at this stage. Even though the clinical features between coronavirus have similarities, Covid-19 are known to present a better clinical picture, exception to elderly patients who have health problems previously which could presented from upper respiratory tract illness to severe pneumonia, ARSA, sepsis, and septic shock [4,14,15].

Laboratory tests carried out to identified coronavirus are using electron microscopy to revealed morphology of the virus, directly assessed the sequence information, and series of genetic amplification (PCR) assays with the guidance from WHO or local ministry [12,16]. After a Covid-19 suspected patient is identified, samples that could be collected from patients are including respiratory material (nasopharyngeal and oropharyngeal swab in ambulatory patient and sputum (if produced) and/or endotracheal aspirate or bronchoalveolar lavage in patients with more severe respiratory disease) and serum for serological testing, acute sample and convalescent sample (this could be used to support the identification of the true agent) [16]. The test could use a pan-coronavirus as the amplification followed by area of the amplicon series which not conserved to characterized and confirmed. The specific Covid-19 can be diagnosed by amplification and detection of the sequence without considering a series of other chains. They should replace by if there were no inadequate laboratory facilities, necessary assistance from the referenced laboratory is important therefore no additional examination or further confirmation is needed. NAAT techniques have been completed and validated by WHO and to diagnose the laboratory-confirmed case of Covid-19, a series of Reverse-Transcriptase Polymerase Chain Reaction (RT-PCR) and sequencing chains of the nucleic acid must be done. A serology test is done to patients with suspected coronavirus infection to confirm the immunological response of pathogens. To gain the best outcome from the serology test, it requires pair samples of serum from the cases that being investigated [14-16].

Therapeutic choice and prevention

Patients with suspected Covid-19 infection are needed an initial therapy of oxygen as soon as possible if they present several conditions such as severe acute respiratory infection, hypoxemia, respiratory failure, or shock. Oxygen therapy to be given initially is 5 L/min and we need to maintain the oxygen pressure target about $SpO_2 \geq 90\%$ in adult patients and $SpO_2 \geq 92 - 95\%$ in pregnant women patients. The hospital should prepared complete oxygenation systems that only be used one time only (nasal cannula, simple masks, and masks with reservoir) and pulse oximetry in all rooms where severe acute respiratory infection patients are treated. When patient showing some signs of shock with a severe acute respiratory infection, fluid therapy can be given. Antibiotic treatment could be given 1 hour after the patient identified sepsis or an empirical treatment if the patients are on Severe Acute Respiratory Infection (SARI) condition. These patients need to be monitored closely because they could easily develop into respiratory failure and sepsis [15,17,18].

Specific treatment for patients with confirmed cases of Covid-19 still has not found by the evidence-based Randomized Control Trial (RCT) [15]. Scientists and health professionals are still working on clinical trials for this specific treatment. Research that was done by Man Wu., *et al.* evaluated the efficiency of the five anti-viruses which have been approved by the Food and Drug Administration (FDA) namely ribavirin, penciclovir, nitazoxanide, nafamostat, chloroquine, and two broad-spectrum antiviruses, remdesivir and favipiravir to against Covid-19 which has been isolated clinically. Data obtained from the study is that remdesivir and chloroquine have great potential against the Covid-19. Remdesivir work against Covid-19 in by targeting Vero cells E6 that has EC90 value about 1.76 μM that shows on this concentrations of drugs can be found non-primate models and this drug is efficient to inhibit viral infection on the human cells structure (human liver cancer Huh-7 cells), that is sensitive against Covid-19 [19]. While SARS-CoV and MERS-CoV have been treated with several drugs including ribavirin, lopinavir and ritonavir, and cathepsin B and cathepsin L [20,21]. Prevention is needed to minimalize transmission could be start from the environmental infrastructures is to ensure adequate ventilation to the health facilities and the household. The easiest way to reduce transmission is by using a surgical mask when in public places, repeatedly washing hands with soap (6 or 7 steps) after doing outdoor activities, before eating, after using the bathroom and practice a correct way of cough etiquette [18,22].

Conclusion

Further studies of the relationship among COVID-19, SARS and MERS is needed to help the future developing of specific antiviral therapies and not to mention its specific prevention, the vaccine for the coronaviruses.

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