Coronavirus Infection Prevention by Wearing Masks

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ABSTRACT

The coronavirus disease 2019 (COVID-19) [2019-nCoV; severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2)] was first detected in Wuhan, China at the end of 2019. In current status, spread of COVID-19 in person-to-person could be caused mainly by respiratory droplets, which leads to the spread of the influenza virus in both community and clinicians. Thus, in order to reduce the risk of that, the urgent management strategies against COVID-19 are to block transmission, isolation, protection, and using drug or vaccine updated on an ongoing basis. unfortunately, no drugs or vaccines still has yet been allowed to treat patients with COVID-19, so the rapid detection of effective intercessions against COVID-19 is seemed a major challenge on the all world. Herein, this article attempts summarizing to introduce the characterization of COVID-19, the influence of droplets travel in person-to-person transmission and the effect of wearing masks in the infection prevention of influenza virus, as well as understanding its advantage and role in the coronavirus infection prevention.

Keywords: Coronavirus, COVID-19, Infection prevention of influenza virus, Wearing masks.

Introduction

The coronavirus disease 2019 (COVID-19) outbreak is one of the hot issues around the world today. As known, the influenza virus (influenza A virus subtype H1N1 (H1N1), severe acute respiratory syndrome (SARS), Middle East respiratory syndrome (MERS), and COVID-19 viruses) outbreak is a threat to human health, as well as a major challenge for both community and clinicians [1-4]. For example, health care workers (HCWs) can initially be at risk and get infected from examining and treating patients with a respiratory infection [5] and then become indiscreet carriers to other patients, family members, and the community if they do not regularly wash their hands or take other infection-preventive measures. In addition, owing to shortages in the availability of antiviral medicine and delays in drug or vaccine development, respiratory protection is one of the key non-pharmaceutical interventions for protection of both community and clinicians. As such, it is truly necessary for each individual in the community and for clinicians to use personal respiratory protective methods to prevent infection of the influenza virus. Therefore, currently, handwashing and wearing masks are one of the ways of preventing infection of the influenza virus. However, currently, there are gaps in the knowledge about the prevention of influenza virus by wearing masks (cloth masks, medical masks, N95 respirators, and surgical masks). Hence, this paper aims to introduce the characteristics of COVID-19, the influence of droplet travel in person-to-person transmission, and the effect of wearing masks in COVID-19 infection prevention.

Characteristics of COVID-19

To date, the emergence and rapid transmission of COVID-19 from patients with severe pneumonia in Wuhan, China, has become a global health concern [6-9]. The features of COVID-19 are similar to those of SARS (or MERS), which is known as a single-stranded RNA b-coronavirus genome with enveloping and positive-sense, ranging from 26 to 32 kilobases in length [10], as well as encoding non-structural, structural, and accessory proteins. Fever, fatigue, and dry cough are considered symptoms of COVID-19. Sometimes, there are a few patients with mild

symptoms and then patients gradually start experiencing aches, nasal congestion, runny nose, sore throat, or diarrhea. Several people who are infected do not develop any symptoms; in particular, older adults and people with underlying medical diseases (diabetes, heart problems, or high blood pressure) are prone to experience serious symptoms, especially those with a history of close contact with COVID-19-infected patients and a history of travel to Wuhan, China. The period of incubation is generally 3–7 days of 14 days [11]. For example, a 65-year-old Chinese man was admitted to Cho Ray Hospital in Ho Chi Minh City, Vietnam [12] and a 35-year-old man was referred to an urgent care clinic in Snohomish, Washington, USA [13], both had cough and fever during the last four days of the incubatory period.

To further understand its characteristics, Huang et al. [9] and Chan et al. [14] showed the multifocal ground-glass changes in the chest and lung computed tomography (CT) scans (Figure 1) that are typical of viral pneumonia. One of the disease development features is the bilateral multiple lobular and sub segmental areas of consolidation found in the chest CT scan. Besides, in CT scan images, the lungs of older patients were further diffused and found to be wider than those of the younger patients [11, 14]. According to some references for the source of the COVID-19 emergence, most of the infected patients were associated with the seafood wholesale market in Wuhan, China [9], or the COVID-19 virus penetrated into the market place before it spread from there [15]; however, the spread of COVID-19 remains largely unknown. Transmission of COVID-19 could be airborne or human-to-human contact; however, both aerosol and fecal-oral transmission still remain unclear [13]. To date, critical public health measures to reduce the transmission of COVID-19 include quarantine both in community and clinicians, as well as timely diagnosis (through testing kits, etc.) and strict participation to prevent the spread of the virus in health care settings [16]. Furthermore, lessons from the influenza virus (H1N1, SARS-CoV, and MERS-CoV) outbreak also support to effectively prepare for COVID-19 outbreak [17].

Main Points

- Arylesterase (ARE) activity could be a useful marker in COPD.
- PON1 RR phenotype was common in COPD and this result is consistent with PON1 genotype studies in COPD.
- Smoking and RR phenotype can be defined independent determinants relation with COPD.

Wearing Masks to Prevent COVID-19 Infection

Influence of droplet travel in person-to-person transmission

As known, reducing transmission of the influenza virus in both community and clinicians may not only help support them but also prevent person-to-person transmission during an influenza virus pandemic. For other protective strategies, drugs or vaccines may be limited in availability. Thus, it is truly necessary for clearly understanding the influence of droplet travel in person-to-person transmission to support the COVID-19 infection prevention. Transmission of COVID-19 could be airborne or through contact, especially large droplets and airborne routes are credited to person-to-person transmission, which could be the cause of a large number of influenza infections, as well as travel of droplets, which involves traveling of droplet-

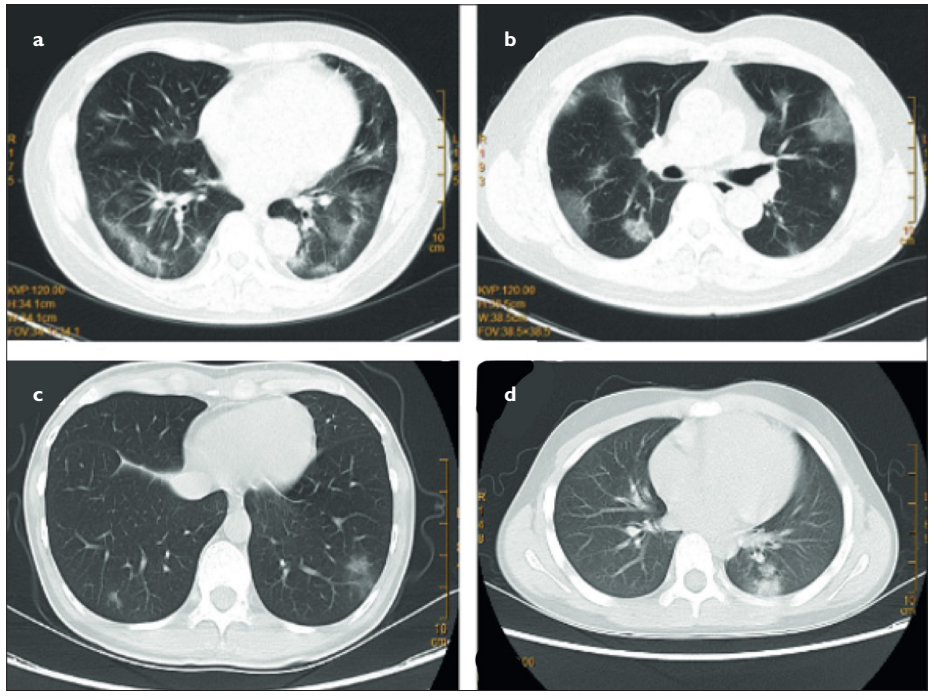

Figure 1. a-d. Images of the thoracic CT scans of patients in a family and the multifocal ground-glass changes in the lungs of mother (a), father (b), daughter (c), and grandson (d) [Reprinted with permission from [14]

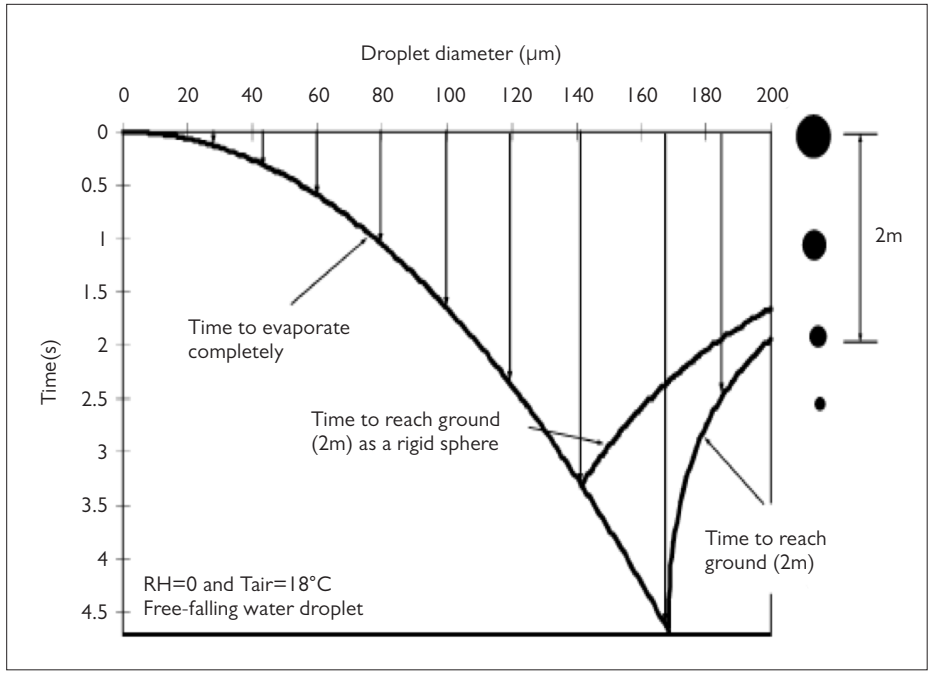

Figure 2. Travel of droplets using Wells evaporation–falling curve. [Reprinted with permission from [37].

borne diseases that can transmit from one person to another. A typical example for travel of droplets is sneezing, which is seen as an exhalation mode with common respiratory symptoms; in particular, respiratory infectious symptoms could create mucus and stimulate various nerves within the nasal mucous membranes and lead to a sneeze. However, the mechanism of the biological dynamics of a sneeze is a little different from that of other respiratory activities. According to some references, the velocity of the exhaled air in sneezing is much larger than that of breathing and coughing [18-20], and the created total number of droplets during the sneeze is also larger than that of other respiratory activities [21]; one can refer to some references of the distribution of size of droplets produced by a cough [22-24], a sneeze [25-27], speech [24, 28, 29], and a breath [24, 30-33], and the concentration and number of droplets [34-36].

Using the Wells evaporation–falling curve (Figure 2) [37, 38], the transmission of droplets is considered to be on the basis of relative humidity, air speed, and respiratory jets, which could be the result of their evaporation and movement from expulsion during respiratory activities. Specifically, Xie et al. [37] calculated both lifetimes and size changes of a droplet, as well as how far the droplets travel. The results showed that the droplets with the largest size possible completely evaporate before falling 2 m away (60-100 μm); these droplets are moved further away by the exhaled air at a suitable velocity (n) (i.e., >6 m [n=50 ms^{-1}] in sneezing, >2 m [n=10 ms^{-1}] in coughing, and <1 m [n=1 ms^{-1}] in breathing). It is really important to develop measures of effective engineering control for the prevention of respiratory infectious symptoms, as well as to explore the person-to-person transmission mechanisms involving travel of droplets of infectious diseases. The results suggested that the rapid evaporation of small droplets and the quick falling of larger droplets on the ground or on surfaces, as well as horizontally deported large droplets could also travel a long distance. Moreover, these droplets could be suspended in the air with low relative humidity conditions, which can lead to the increase in the possibility of subsequent inhalation. Thus, an understanding of the travel of droplets has been significant for developing measures of effective engineering control in the prevention of COVID-19 infection and in exploring the person-to-person transmission mechanisms of infectious diseases. However, respiratory protection demonstrates that aerial transmission is one of the assumed methods of transmission of the influenza virus [39]. The results of trials confirmed that only large droplets are discovered close to the patient, and small droplet nuclei and airborne particles are discovered at a longer distance [40-42]. Besides, the particles with small and large sizes could be found at short distances from the patient, and aerosolized transmission could also occur at a close distance [41].

Finally, the main transmission of COVID-19 is related to the droplets created when a person breathes, talks, coughs, or sneezes. When the droplets travel, they get suspended in the air and quickly fall on the ground or on surfaces. Besides, anyone can become infected with the virus because of breathing within 1 m of person-to-person distance as well as touching a contagious surface followed by touching eyes, nose, or mouth without washing hands.

Effect of Wearing Masks in COVID-19 Infection Prevention

There are some randomized controlled clinical trials (RCTs), which are not only based on handwashing [43-45] but also on wearing masks (cloth masks, medical masks, N95 respirators, and surgical masks) both in community and clinicians [46-49]; however, the trials of wearing masks for respiratory protection are limited, and the effect of wearing masks in the COVID-19 infection prevention is not yet clearly understood. As known, the influenza spread could occur by coughing or sneezing where infectious particles could be inhaled with a range of 0.1-100 μm [50-55]; thus, the personal respiratory protective equipment is really needed to prevent or limit the influenza virus outbreak. Besides, N95 respirators could be unavailable in many countries at short notice of a pandemic; therefore, it is truly important to understand clearly the relative effectiveness of personal respiratory protective equipment. So far, there are a few comparative studies of personal respiratory protective equipment [46,47] and data comparing the surgical mask with the N95 respirator among HCWs [56,57]. Although N95 respirators are not regularly suggested for seasonal influenza, they could play a role in personal protection against the influenza virus pandemic (H1N1, SARS, MERS, and COVID-19 viruses). The result indicates that HCWs wearing surgical masks are not prone to experience influenza compared with those wearing N95 respirators while treating patients with influenza. There are trials for personal protection against respiratory infections, for example, MacIntyre et al. [58] performed RCTs to investigate the effect of medical masks and N95 respirators, proving that N95 respirators provided superior protection against infections of droplet transmission. Besides, to ensure safety and health of HCWs, the superiority of respirators in preventing respiratory infections are also included in infection control guidelines. Currently, there are only five published RCTs in HCWs, which leads to a lack of a common ground around the effect of two kinds of masks (medical masks and N95 respirators) for HCWs against influenza [48, 59-62]. Although N95 respirators have been displayed as superior than medical masks in preventing influenza respiratory infection, there are still no studies that examined the laboratory-confirmed influenza. In other smaller trials, it was found that there is no increase in respiratory diseases between HCWs while wearing medical masks [59]. Besides, there is only one small-scale RCT that compared medical masks and N95 respirators in HCWs [48], concluding that there is no difference, but there is a lack of an arm of controlling. Although medical masks were not designed to provide respiratory protection [63], with lower filtration efficiency, they were designed specifically for personal protection [64-66]. Moreover, they were designed to prevent wound contamination for the surgeon [67-69]. Thus, these large-scale RCTs were also unable to demonstrate any differences between the two kinds of masks in the influenza infection [60, 61]. A recently conducted trial identified the effect of cloth masks compared with medical masks, concluding that cloth masks could increase the risk of infection in HCWs [62]. In addition, the period of wearing the disposable mask, extent to which it protects, and invention of reusable masks should be researched further.

Overall, in the current COVID-19 outbreak, wearing suitable type of masks to prevent COVID-19 infection is truly necessary and limits the infection of the influenza virus. However, there are several important limitations of the RCTs, including the lack of performed measures during the study period and non-collection of data regarding the frequency of device changing [70]. If everyone wears masks, we cannot differentiate between those who are unwell by observing that they are wearing masks. Recently, the World Health Organization suggested that people with respiratory symptoms and those who care for people with symptoms should wear masks [71]. It is truly important to wear and remove masks correctly to reduce the person-to-person transmission of COVID-19 as well as to ensure correct fit of the mask so that it covers the nose and mouth properly [72, 73]. We should use soap with water (or warm water) or hand sanitizer for handwashing, and make sure that the mask covers the nose, mouth, and chin properly, and has adjustable ties to ensure that there are no gaps, and we should avoid touching or adjusting the masks during use. Similar measures are taken while removing a mask, with few

differences: untie the bottom tie of the mask, then remove top tie and remove the mask from the face; the mask must be discarded immediately and cannot be reused. Handwashing is the final step. Moreover, older adults and people with underlying medical conditions are recommended to wear masks, if available.

In summary, to develop effective measures of prevention to control infectious diseases in both community and clinicians, it is necessary to understand clearly the knowledge about prevention of the influenza virus. Because the COVID-19 pandemic is worsening by the hour, individuals need to rapidly respond to this risk. Washing hands diligently, covering coughs, and avoiding crowds and close contact are measures to avoid the risks of transmission in the community. Wearing masks routinely is especially recommended for all individuals to prevent exposure in the community before the vaccine is invented. Therefore, isolation, handwashing, and preventing the spread of the virus are the practical strategies used to tackle the spread of COVID-19. In addition, respiratory protection by wearing masks is one of the methods to prevent infection of the influenza virus; however, trials related to COVID-19 are limited. In addition, the period of wearing the disposable mask, the level of protection of masks, and the invention of reusable masks should be researched further.

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