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The Relationship between COVID-19 and Domestic Animals

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Mini Review

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Abstract

In recent years, a number of diseases have been observed in humans that have their beginning in animal pathogens. The most recent example is the pandemic that shook the whole world - COVID-19. There have been many discussions about the onset of this disease, and since the pandemic was announced, in-depth research has been conducted on the pathogen and the development of the disease in humans. But research on the role of domestic animals in this pandemic has not been sufficiently studied. There are case reports of single cases or a small group of animals. There is a need to deepen research in that area. This mini-review examines and discusses some of the reported cases and aims to direct the scientific community to research on the role of domestic animals in the COVID-19 pandemic.

Objective: To discuss the information about connection of the COVID-19 patients and the spread of the virus from their domestic animals.

Keywords: Covid-19; Sars Cov-2; Cow; Domestic Animals; Zoonosis

Abbreviations: COVID-19: Coronavirus Disease 2019; SARS-CoV-2: Severe Acute Respiratory Syndrome Coronavirus 2; ACE2: Angiotensin-Converting Enzyme 2; MERS-CoV: Middle East Respiratory Syndrome Coronavirus.

Introduction

Human infection diseases are often associated with zoonoses. This occurs when a disease is well prevalent in animals and at some point, crosses the species barrier and is already adapting to use humans as hosts [1]. An example of a zoonosis is the pandemic called coronavirus disease 2019 (COVID-19), which according to some authors plays a key role in minks. These animals are pre-infected with the virus that causes the disease and thus become the main suspects for its spread among people around the world [2]. It all started in December 2019 when a hospital in Ohan, China, reported cases of pneumonia, which has an unclear origin. It is developing relatively fast and for this reason the World Health Organization was notified on December 31. The scientific community is embarking on the difficult task of unraveling the mystery of these cases of pneumonia. Thus, on January 10, 2020, the genomic sequence of a new coronavirus was publicly presented. During this time, the spread of the virus continues. On February 11, 2020 they named the new coronavirus-coronavirus disease 2019 (SARS-CoV-2), and the World Health Organization called the disease COVID-19 [3].

Mini Review

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) is an enveloped RNA virus reported from 2019. It is a big organic compound organization containing structural proteins with defined functions – nucleocapsid, membrane, envelope and spike proteins. The spike protein consists of three protomers arranged in the shape of a crown-corona [4]. The spike protein is a glycoprotein (type I membrane protein) that binds to a receptor onto a host cell. The receptor is angiotensin-converting enzyme 2 (ACE2) [5].

The pandemic caused by the SARS-CoV-2 was named coronavirus disease 2019 (COVID-19). The disease may be asymptomatic, but may be accompanied by cough, muscle aches, fever, and in some cases diarrhea. The disease can develop into pneumonia with severe respiratory distress and even death [6]. Before the appearance of the SARS-CoV-2, two other coronaviruses were the cause of diseases with severe and long-lasting consequences - SARS-CoV-1 and Middle East respiratory syndrome coronavirus (MERS-CoV). The existence of these viruses is often associated with mass deforestation and the entry of animal habitats. Consequently, those coronaviruses are from the group of zoonoses [7]. Human diseases from animal transmission are common – six cases form total ten [8]. Especially for SARS-CoV-2, there are not enough reported evidence about the disease distribution with domestic animals.

There are discussions about the role of the bat in the spread of the COVID-19 [9,10]. Infections in the direction human-to-animal are reported in some countries, including Spain, Belgium, France, United States and Hong Kong. There are studies reporting that positive COVID-19 patients transmit the disease to their pet - being it a dog or a cat, making it sick. Therefore the animal is tested positive for SARS-CoV-2. The animal has positive test for SARS-CoV-2 [10]. Consequently, it is a potential spreader of infection. The quarantine period is only related to human tests, but given that the animal is also a carrier, it is good to rethink this point.

After a global pandemic was caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) in 2020, researchers have been doing experiments in order to proof if domestic animals play a role in the transmission of the virus. Although there have been cases, reporting for SARS-CoV-2 infection in a variety of animals, including cats and dogs [11], there are no cases reporting for SARS-CoV-2 in bovine and cows.

Considering the lack of case reports for SARS-CoV-2 in ruminants, experimental inoculation studies have been done to demonstrate the susceptibility of cattle to the virus. In 2020 Giovanni Di, et al. [12] have done a study on respiratory *ex vivo* organ cultures of domestic ruminant species, highlighting the potential of the animals to be susceptible to infection. However, in an experimental infection of cattle with SARS-CoV-2 in 2020 by Ulrich and colleagues [13], it is concluded that cattle show low susceptibility to the virus. The study was done on 9 cattle, 6 of which were inoculated and the other 3 were in-contact animals. Out of the 6 inoculated animals, 2 later tested positive in PCR of nasal swab samples, however the in-contact animals did not get infected. In another experimental inoculation of young calves with SARS-CoV-2 by Falkenberg, et al. [11] in 2021, it was once again concluded that calves are not susceptible to the infection.

No one discards the animal origin of SARS-CoV-2 [12]. Considering that, another element that has been worrying is the possibility of COVID-19 transmission through bovine milk. The benefits of consuming bovine milk and especially cow's milk are well known to the human population. It is discovered that the bovine immunoglobulins found in the milk can survive through the digestive tract. The immunoglobulins maintain their active binding site which could be helpful in preventing respiratory tract infections in humans [14]. The latter statement leads us to the question "Can SARS-CoV-2 be transmitted through bovine breast milk"? Considering the susceptibility of ruminants to the virus, there is not enough evidence to proof that statement. Further research should be done in order for a conclusion to be made.

However, in a study that evaluated the transmission of SARS-CoV-2 in humans from the mother to the infant through breastfeeding, Yang N, et al. [15] conclude that there is no evidence for possible transmission. The study included 16 breastfeeding mothers with COVID-19. All of the PCR tests of the breast milk samples were negative. All case studies were done with taken precautions such as wearing face masks and hand hygiene in order to limit the risk of transmission during breastfeeding.

Moreover, in another systematic review by Centeno-Tablante, et al. [16] in 2020 assessing the transmission of SARS-CoV-2 through breast milk it is reported for positive breast milk samples for the virus. Moreover, it is claimed that nine out of 84 breastmilk samples were reported positive. In another case an infant was infected with the virus through the breastmilk that was found to be positive. However, it is unclear if the infant had any close contacts with another person diagnosed with SARS-CoV-2.

It is also important to note that it is not possible to evaluate the risk of viral infection through breastfeeding considering many of the studies done so far give little to no information about the precautions taken in order to limit the transmission.

In another prospective multicenter study in Spain done by Bäuerl, et al. [17] in 2021, it is concluded that there was no evidence for the vertical transmission of Covid-19 through breastfeeding, as they did not detect any viral RNA in the breast milk samples. Although in previous research done and based on the available data the overall percent of positive breast milk samples is around 2%-6%. It is important to note that even though the samples were tested positive, it was not possible to isolate viral particles by cell culture [17].

In the midst of such surprising contradictions, it is unclear if SARS-CoV-2 can be transmitted through human breast milk to the infant. There are still many open questions about the

available data and its accuracy, considering the fact that many of the reports do not mention the precautions taken in order to limit the transmission of the infection. Further research should be done in this field. Hence the remaining unanswered question of the possibility of COVID-19 transmission through bovine milk, taking in consideration the possibility of virus transmission from mother to child in humans.

Conclusion

There is limited published literature related to the possibility of transmission of SARS-CoV-2 via bovine milk. COVID-19 has spread through the world as a global pandemic since 2020 and it captured the attention of the health institution. As domestic animals, including ruminants such as bovine, and milk play a huge role in our diets, further research should be done in order to contribute to the evidence of the possibility of virus transmission through the bovine milk or directly from the animal.

Zoonotic pathogens have been known for years. Tracking and dealing with them involves tireless research and the active participation of the scientific community. Today we are facing SARS-CoV 2 and for two years we have been dealing with it. What about tomorrow? Which new and unheard zoonoses awaits us tomorrow and how will we deal with it? We must not forget that animals are a direct substitute for our life and health, and we must protect their health and good life so that we are healthy and whole.

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