Role Of Aerosols In The Spread Of Covid-19- A Review

Ashwini K1, Anjali A K*1, Vinay Sivaswamy2

1Department of General Pathology, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai-77, Tamil Nadu, India
2Department of Prosthodontics and Implantology, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai-77, Tamil Nadu, India

ABSTRACT

The COVID-19 pandemic was identified in late 2019 at Wuhan, China. Its outbreak causes respiratory illness. It is considered to be a potential zoonotic disease and is asymptomatic or flu-like. SARS is a new clinical entity of the COVID-19 outbreak. The other symptoms are fever, sore throat, cold. They spread through droplets, saliva, or sneeze. They are also transmitted to the child by placental transmission. The airborne transmission is by aerosols where droplets are >5 μm. They become bioaerosols and are found to travel more than 100 meters. In experimental work, it is found that the particles of COVID can be detected 3 hours after no clinical setting. The only way to stop the spread is appropriate preventive measures like PPE, respiratory etiquette, and social distancing. There are some recent advances in the field to stop the spread of COVID-19. In this review, we discuss the transmission and spread of coronavirus by aerosols and the various preventive measures used by medical practitioners to stop the spread of this pandemic.

INTRODUCTION

The new public health crisis threatening the world with the emergence and spread of 2019 novel coronavirus (2019-n CoV) (Singhal, 2020). The virus was first originated in bats and was transmitted to humans through unknown intermediary animals COVID-19 originated in the city of Wuhan, Hubei province, China also named as severe acute respiratory syndrome coronavirus (SARS-CoV-2) (Adhikari, 2020). It is asymptomatic or flu-like. It belongs to a subfamily Orthocoronavirinae in the family Coronaviridae (Wu et al., 2020). It is an enveloped RNA virus and has caused the pandemic in early 2020, spreading to nearly 72 countries (Li, 2020a). It is a potential zoonotic disease and endangers life (Singhal, 2020). Some of the symptoms are fever, sore throat, common cold, GI symptoms, and if it exceeds even death (Brundha, 2015). Human to human transmission via droplets, direct contamination, saliva, and sneeze is described with incubation for 14 days (Zhai, 2020). Its cytopathological features include Vero E6 inoculated in throat specimens and tested pathologically (MP and Nallaswamy, 2019). If the smear taken from the throat gets dried, liquid paraffin is used as a rehydrating agent (Harsha and Brundha, 2017). It is proven to have promising results due to the better marginal nuclear details than the routine wet fixed smear (Hannah, 2019). Intensive research on the newly emerged SARS-CoV 2 is urgently needed to elucidate pathological mechanisms and spread the transmissions (Kalaiselvi and Brundha, 2016). In addition to this, the investigated...
treatment options for COVID-19 infection has to be found immediately due to the alarming rate of its spread (Prashanithi and Brundha, 2018).

**Discussion**

**Mode of transmission and origin**

The SARS-CoV 2 is a β-coronavirus which is enveloped with an RNA genome. They have four genera, β and α CoV infect mammals and γ and δ CoV tend to infect birds. β-CoVs and SARS-CoV are severe and potentially fatal respiratory tract infections (Yin and Wunderink, 2018). It was found that the genomic sequence of SARS-CoV 2 is 96.2% identical to that of a bat CoV RaTG13. Based on this, it is suspected that the bat is a natural host of origin and might be transmitted via unknown intermediate hosts to infect humans (Zhou, 2020).

In humans, it is transmitted via respiratory droplets of cough, sneeze, direct contact with objects, and even maternal transmission during the 3rd trimester of pregnancy (Desai and Patel, 2020). The person within 6 meters radius is infected with COVID when an infected person sneezes. The droplets travel by aerosols as in an airborne transmission and affect the people around (Wang and Du, 2020). It is considered to be contagious. The maternal transmission is an asymptomatic carrier transmission (Preethikaa and Brundha, 2018).

Based on that data collected in Wuhan, incubation time ranges generally within 7-14 days (Li, 2020b). The reproduction is doubled after one week. Further studies are needed to understand the mechanisms of transmission and duration of infectivity (Wang and Du, 2020).

**Role of aerosols**

Transmission through aerosols is possible in case of protracted exposure to elevated aerosol concentrations in closed spaces (Cascella, 2020). Aerosols are solid or liquid particles suspended in the air. When coughed or sneezed, the virus is dissolved in aerosol and becomes bio-aerosols (Quadri, 2020). The particles in bio-aerosols are generally 0.3-100 μm in diameter. The bio-aerosols of the size that range from 1-5 μm generally remain in air and layer particles are surface deposited (Yu, 2004). Droplets of saliva are 1-5 mm (Doremalen, 2020). They spread in a space of about 1-2 m from the source of infection. The aerosols can even travel more than 100 meters (Zhang, 2013). Viruses are even detected 3 hrs after aerosolization (Adhikari, 2020). The two possible modes of COVID-19 aerosol transmission are (Lu et al., 2020).

During a sneeze/cough, “droplet sprays” of virus-laden respiratory tract fluids, >5 μm diameter (Todd and Belteton, 2014). Susceptible persons initiate microscopic aerosol particles consisting of residual solid components of evaporated droplets (>5 μm) to remain airborne for hours (Ningthoujam, 2020).

In the dentistry field, there is a significant aerosol transmission due to direct contact with droplets making it a high risk for people under this field (Ge, 2020).

**Experimental work**

The experimental work involved artificially generated aerosols using a nebulizer and maintained in the suspended air with a Goldberg drum. It was found that the virus present in aerosol even after 3 hours, has no clinical setting or infection (Asadi, 2020).

**Reducing aerosol transmission**

In order to reduce the transmission, appropriate Personal Protective Equipment (PPE) should be used (Ravichandran and Brundha, 2016). Hand Hygiene is a must and hands should be sterilized with soap and water or sterlium every 2 hours for 20 seconds (Kumar and Brundha, 2016). Proper respiratory etiquette should be maintained and the mouth should be covered whenever sneezed (Brundha, 2016). Environmental cleaning, like fogging and fumigation, should be done on a daily basis (Shreya and Brundha, 2017). Social distancing among people should be maintained. The public gathering should be availed and for the safety being, home quarantined is the best way possible (Sohrabi, 2020).

**Recent advances in COVID-19 treatment**

These are some of the treatments uptaken and studied experimentally to reduce the transmission of COVID-19.

1. Convalescent Plasma Transfusion (CPT) is one of the new advances that was found to reduce mortality and is appeared to be clinically safe and effective (Balaji et al., 2016). The convalescent patients were asked to donate blood and the convalescent plasma was collected within two weeks after recovery to ensure the neutralization of antibody titer (Shenoy and Brundha, 2016). The difficulty in obtaining plasma is its clinical application (Rajendran, 2020).

2. The most promising antiviral therapy is Remdesivir and it has an in vitro activity against SARS-CoV-2. Other antivirals like chloroquine, arbidol, etc. Are still under research (Senanayake, 2020).
3. The discovery of vaccines is still under progress. It is a long process and further findings and studies are needed to optimize vaccination strategies for the emerging infection (Dong et al., 2020).

4. Radiation therapy is widely used for cancer. But it may be introduced in the treatment of COVID to slow down the rate of growth and killing the pathogen (Rajendran, 2020).

5. It was scientifically proven that regenerative medicine using dental pulpal stem cells can cure any diseases (Brundha et al., 2019). But still, a clinical trial needs to be carried out and can be introduced into the medical field after testing (Timothy et al., 2019).

CONCLUSIONS
The droplets generated by talking, laughing, coughing, and sneezing potentially lead to a generation of an infectious aerosol. The survival of such aerosolized pathogens depends upon environmental conditions such as temperature and RH which both can vary with season and environment. Such aerosols can be transmitted over short and long distances. The airborne transmission can be restricted in 3 ways: Controlling the source of infection by quarantine and isolation, Controlling the use of negative pressure ventilation systems and stopping the transmission routes, Protocol exposed susceptible individuals from both aerosols and contact transmission by use of appropriate PPE.

Acknowledgement
We thank Saveetha Dental College for providing us this platform and encouraging us to do research activities.

Funding Support
The authors declare that they have no funding support for this study.

Conflict Of Interest
The authors declare that they have no conflict of interest for this study.

REFERENCES
Adhikari, S. P. 2020. Epidemiology, causes, clinical manifestation and diagnosis, prevention and control of coronavirus disease (COVID-19) during the early outbreak period: a scoping review. Infectious Diseases of Poverty, 9(1):1–12.

Asadi, S. 2020. The coronavirus pandemic and aerosols: Does COVID-19 transmit via expiratory particles? Aerosol science and technology: the journal of the American Association for Aerosol Research, pages 1–4.

Balaji, S., Brundha, M. P., Path, D. N. B. 2016. Awareness of About Breast Cancer among Dental Surgeons. Journal of Pharmaceutical Sciences and Research, 8(8).

Brundha, F. 2016. Awareness of Stye. International Journal of Pharmaceutical Sciences Review and research, 40(1):30–32.

Brundha, M. P. 2015. A Comparative Study-The Role of Skin and Nerve Biopsy in Hansen’s Disease. Journal of Pharmaceutical Sciences and Research, 7(10).

Brundha, M. P., Pathmashri, V. P., Sundari, S. 2019. Quantitative Changes of Red Blood cells in Cancer Patients under Palliative Radiotherapy-A Retrospective Study. Research Journal of Pharmacy and Technology, 12(2):687–687.

Cascella, M. 2020. Features, Evaluation and Treatment Coronavirus (COVID-19). StatPearls Publishing, StatPearls. Treasure Island (FL).

Desai, A. N., Patel, P. 2020. Stopping the Spread of COVID-19. JAMA, 323(15):1516–1516.

Dong, L., Hu, S., Gao, J. 2020. Discovering drugs to treat coronavirus disease 2019 (COVID-19). Drug Discoviers & Therapeutics, 14(1):58–60.

Doremalen, N. V. 2020. Aerosol and surface stability of SARS-CoV-2 as compared with SARS-CoV-1. The New England journal of medicine, 382(16):1564–1567.

Ge, Z. Y. 2020. Possible aerosol transmission of COVID-19 and special precautions in dentistry. Journal of Zhejiang University. Science. B. Springer, 21(5):361–368.

Hannah, R. 2019. Liquid Paraffin as a Rehydrant for Air Dried Buccal Smear. Research Journal of Pharmacy and Technology, 12(3):1197–1200.

Harsha, L., Brundha, M. P. 2017. Prevalence of dental developmental anomalies among men and women and its psychological effect in a given population. Journal of Pharmaceutical Sciences and Research, 9(6):869–869.

Kalaiselvi, R., Brundha, M. P. 2016. Prevalence of hysterectomy in South Indian population. Research Journal of Pharmacy and Technology, 9(11):1941–1941.

Kumar, M. D. A., Brundha, M. P. 2016. Awareness about nocturia-A questionnaire survey. Research Journal of Pharmacy and Technology, 9(10):1707–1707.

Li, H. 2020a. Coronavirus disease 2019 (COVID-19):
current status and future perspective. *International Journal of Antimicrobial Agents.*

Li, Q. 2020b. Early Transmission Dynamics in Wuhan, China, of Novel Coronavirus-Infected Pneumonia. *The New England Journal of Medicine. Massachusetts Medical Society*, 382(13):1199–1207.

Lu, J., Gu, J., Li, K., Xu, C., Su, W., Lai, Z., Yang, Z. 2020. COVID-19 outbreak associated with air conditioning in the restaurant. *Emerging infectious diseases*, 26(7):1628–1628.

MP, B., Nallaswamy, D. 2019. Hide and seek in pathology: A research on game-based histopathology learning. *International Journal of Research in Pharmaceutical Sciences*, 10(2):1410–1414.

Ningthoujam, R. 2020. COVID-19 can spread through breathing, talking, study estimates. *Current Medicine Research and Practice*, 10(3):132–133.

Prashanthi, N., Brundha, M. P. 2018. A Comparative Study between Popplet Notes and Conventional Notes for Learning Pathology. *Research Journal of Pharmacy and Technology*, 11(1):175–175.

Preethikaa, S., Brundha, M. P. 2018. Awareness of diabetes mellitus among general population. *Research Journal of Pharmacy and Technology*, 11(5):1825–1825.

Quadri, M. F. A. 2020. Novel coronavirus disease (COVID-19) awareness among the dental interns, dental auxiliaries and dental specialists in Saudi Arabia: A nationwide study. *Journal of infection and public health*, 13(6):856–864.

Rajendran, K. 2020. Convalescent plasma transfusion for the treatment of COVID-19: Systematic review. *Journal of medical virology.*

Ravichandran, H., Brundha, M. P. 2016. Awareness about personal protective equipments in hospital workers (sweepers and cleaners) - Research. *International Journal of Pharmaceutical Sciences Review and Research*, 40(1):28–29.

Senanayake, S. L. 2020. Drug repurposing strategies for COVID-19. *Future Drug Discovery*, 2(2).

Shenoy, P. B., Brundha, M. P. 2016. Awareness of polycystic ovarian disease among females of age group 18-30 years. *Journal of Pharmaceutical Sciences and Research*, 8(8).

Shreya, S., Brundha, M. P. 2017. Alteration of Haemoglobin Value in Relation to Age, Sex and Dental Diseases-A Retrospective Correlation Study. *Research Journal of Pharmacy and Technology*, 10(5):1363–1363.

Singhal, T. 2020. A Review of Coronavirus Disease-2019 (COVID-19). *The Indian Journal of Pediatrics*, 87(4):281–286.

Sohrabi, C. 2020. World Health Organization declares global emergency: A review of the 2019 novel coronavirus (COVID-19). *International journal of surgery*, 76:71–76.

Timothy, C. N., Sanyuktha, P. S., Brundha, M. P. 2019. Dental pulp Stem Cells in Regenerative Medicine – A Literature Review. *Research Journal of Pharmacy and Technology*, 12(8):4052–4052.

Todd, M. C., Belteton, M. V. F. 2014. Factors Involved in Aerosol Transmission of Infection and Control of Ventilation in Healthcare. *Noninvasive Ventilation in High-Risk Infections and Mass Casualty Events*, pages 269–277.

Wang, J., Du, G. 2020. COVID-19 may transmit through aerosol. *Irish Journal of Medical Science.*

Wu, Y. C., Chen, C. S., Chan, Y. J. 2020. The outbreak of COVID-19: An overview. *Journal of the Chinese Medical Association: JCMA. ncbi.nlm.nih.gov*, 83(3):217–220.

Yin, Y., Wunderink, R. G. 2018. MERS, SARS and other coronaviruses as causes of pneumonia. *Respirology*, 23(2):130–137.

Yu, I. T. S. 2004. Evidence of airborne transmission of the severe acute respiratory syndrome virus. *The New England journal of medicine*, 350(17):1731–1739.

Zhai, P. 2020. The epidemiology, diagnosis and treatment of COVID-19. *International Journal of antimicrobial agents*, 55(5):105955–105955.

Zhang, H. 2013. Airborne spread and infection of a novel swine-origin influenza A (H1N1) virus. *Virology Journal*, 10(1):1–7.

Zhou, P. 2020. A pneumonia outbreak associated with a new coronavirus of probable bat origin. *Nature. nature.com*, 579(7798):270–273.