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Covid 19: A Potential Hazard for Dental Health Care Workers

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Abstract

Corona virus disease 2019, also called as COVID 19 is the latest infectious disease to rapidly develop worldwide. A novel β- Corona virus (2019 n COV) cause severe and even fatal pneumonia explored in sea food market of Wuhan City, Hubei province, China & rapidly spread to other countries. The person to person transmission routes of COVID 19 include direct transmission such as cough, sneeze, droplet inhalation, contact transmission and saliva. Due to the unique nature of dentistry, most dental procedures generate significant amounts of droplets & aerosols, posing risk of infection transmission. Dentists are often the first line of diagnosis as they are exposed to tremendous risk of COVID 19 due to face to face communication and exposure to saliva and blood and handling of sharp instruments. Thus, understanding various routes of COVID 19 transmission and their implications the dental set up can facilitate the prevention of cross infections between patients and the Dental Health Care Workers.

Keywords: COVID 19, Aerosols and Saliva, Transmission routes, Dental practice.

Introduction

COVID 19 is a newly discovered viral infection that started in Wuhan, China and caused the infection to spread globally, resulting in2019-2020 Pandemic as declared by WHO and Public Health Emergency of International Concern (PHEIC)[1]. A Novel Coronavirus (COVID 19) is associated with human to human transmission. The COVID 19 was recently identified in Saliva of infected patients[2] and thus Saliva can have a pivotal role in human to human transmission. Due to peculiar characteristics of Dental settings, the risk of cross infections may be high between Dental Practitioners and Patients. Dental care Personnel invariably carry the risk of contacting or transmitting COVID 19 infection as it is hard to avoid the generation of large amounts of aerosol and droplets mixed with Patient's saliva and blood or oral fluids during Dental Practice. Dentists, thereby, should entertain a high level of

awareness and integrity to deal with the disease and be able to control and manage the spread of COVID 19.

Characteristics of 2019 Novel Coronavirus

Coronavirus belong to the Family Coronaviridae comprising large, single, plus stranded RNA as their Genome. Currently there are four Genera of Coronavirus: α-Cov, β-Cov, ɣ-Cov, δ-Cov[3,4]. Most of the Coronavirus can cause the infectious disease in humans and vertebrates. The α Cov, β Cov mainly infect the respiratory, gastrointestinal and CNS of humans and mammals while ɣ Cov, δ Cov mainly infect the birds[5].

Usually, several members of the Coronavirus cause mild respiratory disease in humans, however SARS-COV & Middle East Respiratory Syndrome Coronavirus (MERS-COV) belonging to β- Cov cause severe fatal respiratory disease[5].The 2019–n Cov is different from SARS-COV but shared the same host receptor, the Human Angiotensin-Converting Enzyme (ACE2). The natural host of COVID 19 may be the Bat Rhinolophus Affinis as 2019- n Cov showed 96.2% of whole genome identity to Bat Cov Ra TG13[5].

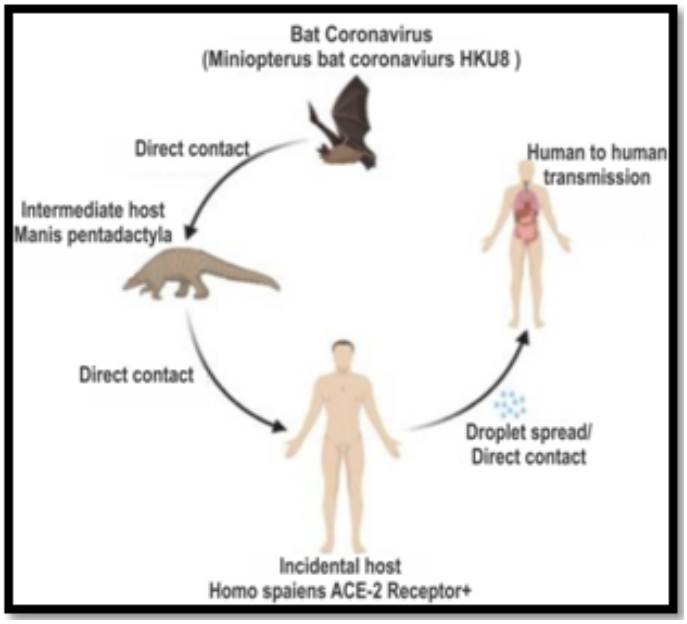

Fig 1: Transmission of SARS COV 2

2019-n Cov possess the typical Coronavirus structure with the “spike protein” in the membrane envelope (Fig 2) and also expressed other polyproteins, nucleoproteins and membrane proteins[6,7]. The S Protein from the Coronavirus can bind to the receptors of the host to facilitate the viral entry into the Target cells which will bind to the ACE2 Receptor from the Humans, Bat, Civet and Pigs[5].

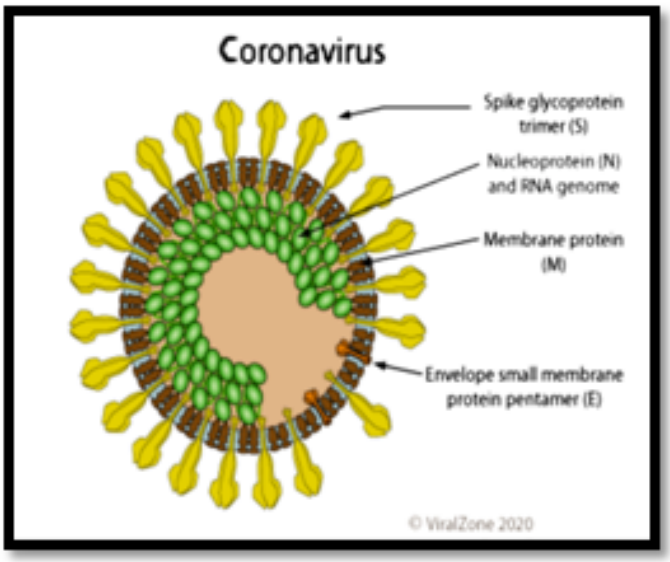

Fig 2: Structure of a Coronavirus

Source of Transmission of Covid 19 and Incubation Period

Although patients with symptomatic COVID 19 have been the main source of transmission but several recent observations suggest that the asymptomatic patients and patients in their incubation period are also carriers of SARS – COV -2 which has made its control extremely challenging.

Incubation period: The incubation period of COVID 19 has been estimated to be 5- 6 days on average but there is evidence that it could be as long as 14 days, which is now commonly adopted duration for medical observation and quarantine of exposed persons[8].

Clinical Manifestations

Majority of patients experienced Fever and Dry Cough while some also had shortness of breath, fatigue and other atypical symptoms such as muscle pain, confusion, headache, sore throat, diarrhea and vomitings. Among

patients who underwent chest Computed Tomography, most patients showed bilateral Pneumonia with ground glass opacity and bilateral patchy shadows. In general, older age and existence of underlying comorbidities have been found to be associated with poor prognosis.

Thus, main focus of this review is to summarize various possible routes of COVID 19 transmission and its association in Dental Practice as Dentists are at high risk for exposure to COVID 19 owing to the specific Dental procedures that generates Aerosols and have face to face communication.

Covid 19 and Dental Practice

Dental care settings invariably carry the risk of COVID 19 infection due to the specificity of its procedures which involves face to face communication with patients and frequent exposure to Saliva, blood and other Body fluids and handling of sharp instruments. Transmission of Coronavirus from contaminated dry surface has also been postulated including self inoculation of mucous membrane of nose, eyes or mouth, emphasizing the importance of a detailed understanding of Coronavirus

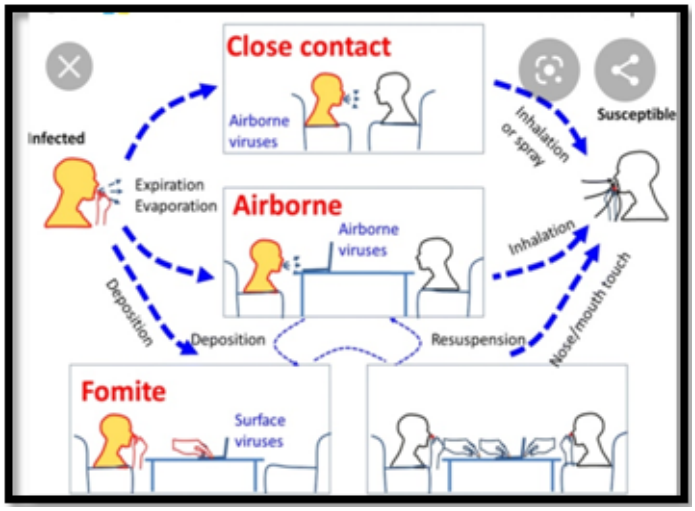

Fig 3(a): Possible sources of transmission of COVID19 from an individual

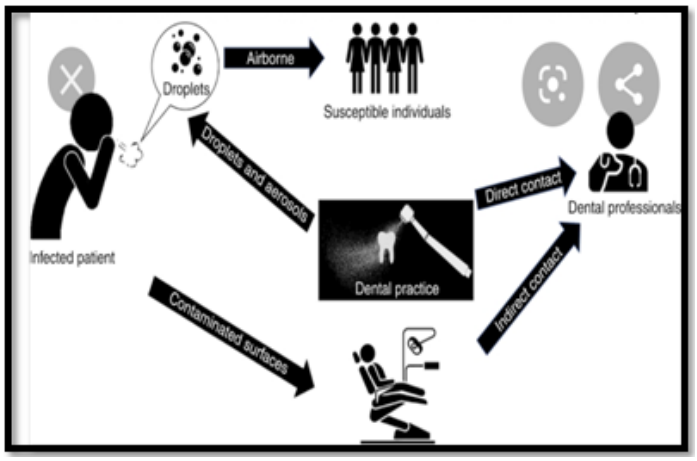

Fig 3(b): Transmission of Covid19 in a Dental set up

Air Borne/Droplet Spread of Coronavirus and Its Implication in Dental Practice

Aerosols are dispersion of air of particles of variety of sizes. The larger of these particles rapidly settle out, but particles of smaller size can remain suspended in air for longer periods. Under real conditions, the time during which aerosol particles remain suspended and the distance with which they can travel from the point of their generation are greatly influenced by airflow and turbulence.

The particles produced during sneezing and speaking (particularly when pronouncing sibilants) are generally larger and most of them rapidly settle out of air. Coughing, on the other hand is known to produce more small particle aerosols which are potentially better suited for the airborne spread of viral infections (Table 1)[10].

Activity	Approximate particle count	Units
Sneezing [36]	40,000	Per sneeze
Bowel evacuation [37]	20,000	Per event
Vomiting [38]	1,000	Per event
Coughing [36]	710	Per cough
Talking [36]	36	Per 100 words

Table 1: Droplet or airborne microorganisms released from various activities

Upon aerosolization, and depending on the level of relative humidity and at atmospheric temperature, most of

water from aerosolized particles of small size evaporates almost immediately which leaves behind a residual particle that may contain organic and inorganic as well as biological agents. Residual particles of this type (usually <5µm in dia) are referred to as "Droplet Nuclei" and if the biological agent in them are not damaged by the drying process, they are then potentially infective for susceptible host species. Under conditions of normal aerial turbulence, droplet nuclei can remain air borne for prolonged periods of time. Inhalation of air containing these particles can lead to their retention in the respiratory tract[11].

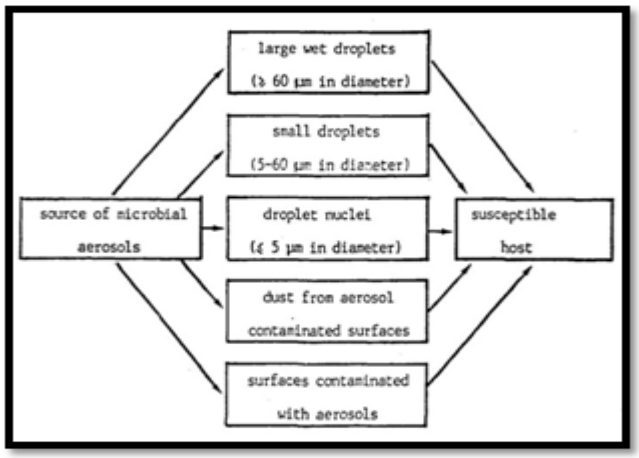

Figure 4 a

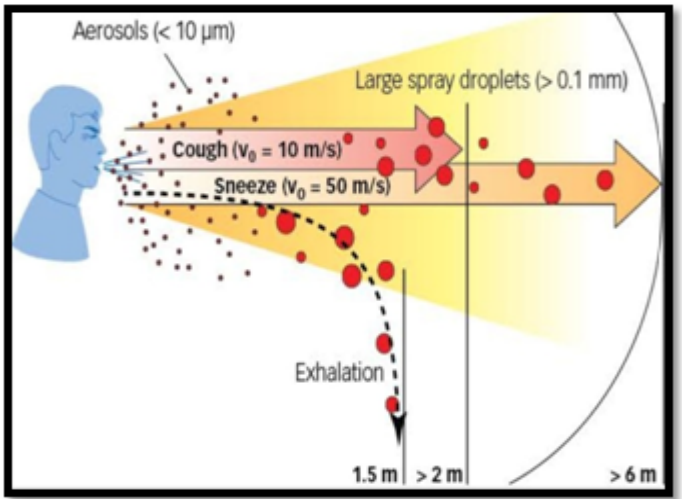

Figure 4 b

Fig 4 (a) & (b): Possible ways of spread of infection through aerosols

Airborne Transmission of Covid 19 in A Dental Set UP

Most Dental procedures that use mechanical instrumentation will produce airborne particles from the site where the instrument is being used. Dental handpieces, ultrasonic scalers, air polishers, three way syringes and in air abrasion units produce the most viable aerosols.

When performing Dental procedures with a high speed handpiece, friction between the tooth and rapidly rotating bur would create excessive heat. Without a coolant, the heat could cause damage to hard dental tissues and thusly to prevent heat gain, it is mandatory to use a water coolant which however could generate aerosols. When combined with bodily fluids in the oral cavity, such as blood and saliva, Bioaerosols are created[12]. Thus, outbreak of COVID 19 has clearly placed Dental Health Practitioners at a greater risk as a result of generation of potential large number of aerosols in the Dental set up.

Fig 5 (a)

Fig 5 (b)

Fig 5 (c)

Fig 5 (a), 5(b), 5(c): The visible aerosol cloud produced by different instruments used in a Dental set up

Persistence of Coronavirus on Inanimate Surfaces

Human Coronavirus can remain infective on inanimate surfaces at room temperature for upto 9 days. At a temperature of 30^0 C or more, the duration of persistence is shorter.

Contamination of frequent touch surfaces in Dental settings are therefore a potential source of viral transmission. The data on the persistence of all Coronaviruses on different types of inanimate surfaces is summarized in Table 2[9].

Type of surface	Virus	Strain / isolate	Inoculum (viral titer)	Temperature	Persistence
Steel	MERS-CoV	Isolate HCoV-EMC/2012	10^5	20°C	48 h
				30°C	8–24 h
	TGEV	Unknown	10^6	4°C	≥ 28 d
				20°C	3–28 d
				40°C	4–96 h
	MHV	Unknown	10^6	4°C	≥ 28 d
				20°C	4–28 d
				40°C	4–96 h
	HCoV	Strain 229E	10^3	21°C	5 d
Aluminium	HCoV	Strains 229E and OC43	5×10^3	21°C	2–8 h
Metal	SARS-CoV	Strain P9	10^5	RT	5 d
Wood	SARS-CoV	Strain P9	10^5	RT	4 d
Paper	SARS-CoV	Strain P9	10^5	RT	4–5 d
	SARS-CoV	Strain GVU6109	10^6	RT	24 h
			10^5		3 h
			10^4		< 5 min
Glass	SARS-CoV	Strain P9	10^5	RT	4 d
	HCoV	Strain 229E	10^3	21°C	5 d
Plastic	SARS-CoV	Strain HKU39849	10^5	22°-25°C	≤ 5 d
	MERS-CoV	Isolate HCoV-EMC/2012	10^5	20°C	48 h
				30°C	8–24 h
	SARS-CoV	Strain P9	10^5	RT	4 d
	SARS-CoV	Strain FFM1	10^7	RT	6–9 d
	HCoV	Strain 229E	10^7	RT	2–6 d
PVC	HCoV	Strain 229E	10^3	21°C	5 d
Silicon rubber	HCoV	Strain 229E	10^3	21°C	5 d
Surgical glove (latex)	HCoV	Strains 229E and OC43	5×10^3	21°C	≤ 8 h
Disposable gown	SARS-CoV	Strain GVU6109	10^6	RT	2 d
			10^5		24 h
			10^4		1 h
Ceramic	HCoV	Strain 229E	10^3	21°C	5 d
Teflon	HCoV	Strain 229E	10^3	21°C	5 d

Table 2 : Persistence of Coronavirus on various metals and inanimate surfaces

WHO recommends to ensure that environmental cleaning and disinfection procedures performed are consistent and correct so as to limit the chances of cross infection. WHO also recommends to preferably apply alcohol based hand rubs for decontamination of hands after removing gloves. Dilution of 1:50 of standard bleach is recommended for disinfection of inanimate surfaces. For the disinfection of small surfaces Ethanol revealed a similar efficacy against Coronavirus. A concentration of 70% Ethanol is also recommended by WHO for disinfecting small surfaces[9]. Understanding of review on Persistence of Coronavirus on different surfaces and use of correct concentration of biocidal agents to prevent such persistence will help in intercepting the cross infections.

Salivary Glands: A Potential Reservoir For Covid 19 Asymptomatic Infections And Role Of Saliva As A Diognostic Marker

The shedding of Severe Acute Respiratory Syndrome Coronavirus into saliva play a critical role in viral transmission. Studies have suggested that ACE2/Cytokeratin cells lining the salivary gland ducts are early target cells of SARSCOV and a likely source of

virions found in patient's saliva droplets especially early in infections. ACE2 is an important receptor for COVID 19. In previous studies about Severe Acute Respiratory Syndrome (SARSCOV), epithelial cells of salivary glands with high expression of ACE2 were found to be infected[13]. The expression of ACE2 in minor salivary glands was higher than that in lungs (Lung medium PTM [Transcripts per Kilo base of exonmodel per Million mapped reads] =1.010,minor salivary gland medium PTM=2.013, which suggests salivary glands could be a potential target for COVID19. In addition, SARSCOV can be detected in saliva before lung lesions appear (Wang et al 2004). This may explain the presence of asymptomatic infections. For SARSCOV, the salivary gland could be major source of virus in saliva. The positive rate of COVID19 infected patient's saliva can reach 91.7 % and saliva samples can also cultivate the live virus (To et al 2020). This suggests that COVID19 transmitted by asymptomatic infection may originate from infected saliva. Therefore, the course of asymptomatic infection might be from salivary glands[14].

Rapid and accurate detection of COVID19 is crucial in controlling the outbreak in the community and hospitals. Nasopharyngeal and esophageal swabs are the recommended upper tract specimen types for COVID19 diagnosis. However, the collection of these specimen types requires close contact between healthcare workers and the patients which pose a risk of transmission of the virus to the healthcare workers. Furthermore, the collection of nasopharyngeal and esophageal causes discomfort and may cause bleeding especially in patients with thrombocytopenia[15]. Hence, nasopharyngeal or esophageal swabs are not desirable for serial monitoring of viral load. Sputum is a noninvasive lower respiratory tract specimen but only 28% of patients with COVID19 in one case series could produce sputum for diagnostic evaluation[16].

Saliva specimen can be provided easily by asking the patients to spit into a sterile bottle. Since, no invasive procedures are required, the collection of saliva can greatly minimize the chance of exposing healthcare workers to COVID19. Further, studies are needed to investigate the potential diagnosis of COVID19 in saliva and its impact on transmission of this, which is crucial to improve effective strategies for prevention especially for Dental Health Care Workers that perform aerosol generating procedures. Saliva can have pivotal role in human to human transmission and salivary diagnostics may provide a convenient and cost effective point of care platform for COVID19 infection.

Conclusion

Coronavirus disease 2019, also called COVID 19 is the latest infectious disease to rapidly develop worldwide. Human to human transmission have been described with the incubation period of 2-10 days facilitating its spread via droplets, contaminated hands or surfaces. Dentists, by nature are at high risk of exposure to infectious disease. The emergence of COVID19 has brought new challenges and responsibilities to Dental Professionals. A better understanding of viral features and its various routes of transmission and potential reservoirs could help in preventing and intercepting the transmission of this rapidly spreading disease.

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