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Aerosol and COVID-19: An Inevitable Contaminant in Dental Practice

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ABSTRACT

Aerosols are liquid or solid particles suspended in the air by humans, animals, instruments or machines, In a dental clinic environment, the dentist, their staff and the patients are daily exposed to a great variety of infectious agents and toxic substances transported by aerosols and droplets, promoting an increased risk of cross-infection. Especially during this pandemic of SARS-CoV-2,the dental profession was considered riskier because of the aerosolsgenerated during various dental procedures. Therefore, through this paper, we would like to focus on the adverse effects of aerosol, how it poses as a hazard in dentistry, it being a potential means of transmission of SARS-CoV-2 in a dental set-up and finally, the measures that can be taken to reduce aerosol production as much as possible in a dental clinic to make it safer for the dentist as well as the patient.

Key words: Aerosol, Splatter, Dental practice, SARS-CoV-2

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INTRODUCTION

Aerosols are defined as liquid or solid particles suspended in the air by humans, animals, instruments or machines. Bioaerosols are aerosols consisting of particles of any kind of organism.[1]When compared with aerosols which are less than 50 microns in diameter, splatter is usually described as a mixture of air, water and/or solid substances such as fragments of dental fillings, carious tissues, sandblasting powder, etc which are more than 50 microns in diameter[2]. Dentists use high-energy equipment, like drills and scalers, in the presence of fluids like blood and saliva, and dental plaque. This combination has been shown to generate aerosols of oral microorganismsand blood [3].

An aerosol or droplet nuclei may be present in the air of the dental set-up for up to half an hour after a procedure. At the end of a working day, 30 minutes after treatment cessation, bacterial contamination levels decrease by 50-70%. Research concluded that bioaerosols return to baseline 2 hours after the dental treatment [4]. This means that after a procedure if the operator removes a protective barrier such as a face mask to speak to a patient when a procedure is completed, the potential for contact with airborne contaminated material persists. Also, there is a potential for an airborne contaminant to enter the ventilation system and spread to areas of the facility where barrier protection is not used [5].

During this pandemic of SARS-CoV-2, the dental profession was considered riskier because of the aerosolsgenerated during various dental procedures. Through this paper, we want to focus on aerosols, their hazards and ways to reduce aerosols in a dental operatory.

Dentistry and aerosols

A study has shown that dentists report more frequent and worse health problems than other high-risk medical professionals. Because of the nature of their profession, dental practitioners are more prone to acquire different infections. Performing procedures in close proximity to the patient's mouth, using sharp instruments excessively, performing dental procedures capable of producing light and heavy particles are some of the common reasons forspreading cross-infection among dental practitioners. The production of airborne material during dental procedures is potentially hazardous to the dentist, the dental team and the patient. The ultrasonic scalers have shown to generate the greatest amount of airborne

contamination, followed by the air-driven high-speed handpiece, the air polisher and various other instruments such as the air-water syringe and prophylaxis angles.[5]An aerosol cloud of particulate matter and fluid often is clearly visible during dental procedures, during tooth preparation with a rotary instrument or air abrasion, during the use of an air-water syringe, during the use of an ultrasonic scaler and during air polishing. This ubiquitous aerosolized cloud is a combination of materials originating from the operating site and the dental unit waterlines.Ultrasonic scalers use water as a coolant that is splattered during the vibration of the tip. The splatter when mixed with saliva and plaque of the patients causes the aerosol to become highly infectious and act as a major risk factor for transmission of the disease. The predominant microorganisms isolated from bioaerosols in dental clinics are Staphylococcus and Micrococcus species. The concentration of anti-Legionella antibodies was reported to be higher in dental staff as compared to the general population, thus conclusive that water in dental unit waterlines may be a potential reservoir for infection.[4]A dental clinic is a sight that is prone to cause infections that are bacterial or viral. These can be transmitted via the following ways:

- Direct exposure to blood, oral fluids or patient mucosal surfaces.
- Contact of conjunctiva or mucosa having droplets generated from infected fluids. These droplets can travel a short distance as they are propelled, e.g.- by coughing, sneezing, or talking
- Airborne droplets suspended in the air for a long period can be inhaled.

It has long been recognized that particles expelled during human expiratory events, such as sneezing, coughing, talking, and breathing, serve as vehicles for respiratory pathogen transmission. When patients harbor viruses, either blood-borne or respiratory or respiratory bacterial pathogens such as Mycobacterium tuberculosis, aerosol generation may prove a significant health hazard to the dentists and their assistants. If infective aerosols persist, there may be some danger of exposure in the waiting area and for subsequent patients.[3]Dentists who treat patients using aerosolization are at an extremely dangerous risk of inoculation ofthemselves, their dental assistantsandother office staff members. One study found that ultrasonic instrumentation can transmit 1,00,000 microbes per cubic foot with aerosolization of up to six feet and if improper air current is present, microbes can last anywhere from 35 minutes to 17 hours. There is some evidence for a greater prevalence of respiratory diseases and elevated antibody levels to Legionella pneumophila in dental workers. These droplets are relatively heavy so they do not travel very far; instead, they fall from the air after traveling up to six feet. Aerosols can float in the air for a considerable time before being inhaled by dental staff and other patients. The problem occurs when viral particles are aerosolized by a cough or sneeze. In these instances, particles can potentially travel across far greater distances, up to 20 feet, from an infected person and cause secondary infections elsewhere in the environment. These aerosolized droplet nuclei can remain in an area, suspended in the air, even after the person who emitted them has left and can infect health-care workers and contaminate surfaces.Oral bacteria have been detected two meters from the procedure field indicating the existence of aerosolized oral bacteria in dental practice [1].

Transmission of SARS-CoV-2 in dental health care workers:

SARS-CoV-2 – the virus that causes severe acuterespiratory syndrome(SARS)– is a virulent coronaviruscontaining RNA. Because it is a relatively new virus, health care personnel are particularly at risk The transmission of the virus mainly occurs via respiratory droplets and fecal shedding. These respiratory droplets are released from the oral cavity and pharynx by speech,and usually do not reach more than 1.5–2 m. When coughing and sneezing too, aerosols are generated, which remain in the airfor some time. Although aerosols do not play a major role in the transmission of SARS-CoV-2 in most daily activities, the situation is different in the dental clinic. Aerosols are caused by water in combination with compressed air used for coolant and spraying which become contaminated with micro-organisms from the oral cavity. Dental health care workers operate at a distance of 60 cm or less from a patient's oral cavity.It was shown in a recent study that the largest microbiological contamination within the dental healthcare clinic takes place within 1 m from the oral cavity, via splashes as well as aerosols. Moreover, many virus particles are seen in the saliva and on the dorsum of the tongue of a SARS-CoV-2 positive patient. This suggests that aerosols generated during dental healthcare treatment in these individuals can also contain SARS-CoV-2 and thereby transmit the virus to the dental health care workers. Even on the completion of the treatment, aerosols are seen suspended in the air within the treatment room.Viability of SARS-CoV-2 aerosols on various things, like the virus is viable for up to 72 hours on plastic and stainless steel surfaces, up to 24 hours on cardboard surfaces, up to 9 hours on copper surfaces and is viable in suspended aerosols up to 3 hours.

Regardless of the modes of transmission,the minimal infectious dose of SARS-CoV-2 has not yet been established. Therefore, irrespective of the level of contamination, all the surfaces contaminated with aerosol or touched by the patients should be regarded as potentially contaminated [2].

METHODOLOGY OF PREVENTION

In a dental clinic environment, the dentist, their staff and the patients are daily exposed to a great variety of infectious agents and toxic substances transported by aerosols and droplets, promoting an increased risk of cross-infection. Reducing the aerosol production and microbial load in the water units will reduce the chances

of cross-contamination in the dental set-up.There are at least three potential airborne infection sources during dental procedures: dental equipment,operative site and saliva and respiratory sources.[5]Infection control measures might not only reduce the probability of infection but might also reduce the size of the inhaled particles, which has been associated with disease severityin influenza and other diseases.

Personal protective equipment(PPE)

Health-care workers should protect themselves from various potentially infectious aerosols when working in close proximity to patients. thus emphasizing the use of a familiar triad—gloves, masks and eyewear—for all operative procedures.

Masks versus respirators: A study in the UK found that surgical masks could reduce inert aerosol exposure by two times, but filtering facepiece respirators reduced the exposure by a factor of 100 or higher. The use of a high-performance n95 respirator could prevent exposure to hazardous concentrations of airborne pathogens. Masks will only filter out 60 to 95 percent of aerosols, subject to leakage if not well-fitted.Surgical masks and other respirators require a face shield or goggles to protect the eyes and prevent infection. Face shields can decrease inhalation exposures to wearers and surface contamination of filtering facepiece respirators by aerosol particles of larger particles(approx. 8•5 μm) by 96% and 97% respectively,but only reduce inhalation exposures to smaller particle aerosols (approx. 3•4 μm) by 23%.

Limitation: Further, while the use of PPE eliminates much of the danger from splatter or larger particles, aerosols still have the potential to be inhaled via leaks in the mask and to go around safety glasses [3].

High volume evacuator (HVE):

The usual high volume evacuator used in dentistry has a large opening (usually 8 millimeters or greater) and is attached toan evacuation system that willremove a large volume of air (up to100 cubic feet of air per minute).

Ultrasonic and sonic scalers areconsidered the greatest source of aerosol contamination and studies show that the use of a high-volume evacuator while ultrasonic and sonic scaling and air polishing will reduce airborne contamination by more than 95 percent. [5] In case of air abrasion, the device combines a barrier device to help contain theabrasive material and a vacuum to remove the abrasive material and the airborne particles created by the procedures[5]Using a high volume evacuator along with an air-water syringe will reduce airborne bacteria by nearly 99 percent.

Limitation: A sucking device, does not eliminate splatter effectively because the large particles, due to their high kinetic energy, escape from the range of the air stream flowing from a handpiece.

Preprocedural mouthrinse:

One method of reducing overall bacterial counts produced during dental procedures is the use of a preprocedural rinse. Veksler concluded that two consecutive pre-procedural rinsings with 15ml of 0.12% chlorhexidine for 30 seconds had up to 97% reduction in salivary bacterial load and have a sustained effect on the salivary bacterial load. [1]

Limitation: While preprocedural rinses will reduce the extent of contamination within dental aerosols as routinely measured on agar plates, they do not eliminate the infectious potential of dental aerosols.

Rubber dam:

During many dental procedures, the use of a rubber dam will eliminate virtually all contamination arising from saliva or blood. If a rubber dam can be used, the only remaining source for airborne contamination is from the tooth that is undergoing treatment, thus limiting the contamination to airborne tooth material and any organisms contained within the tooth itself.

Limitation: In certain procedures such as subgingival restorations, finishing of crown preparation, root planning and periodontal surgery, it often is difficult to use a rubber dam.[5]}

Methods to reduce airborne contamination arising from the operative site:

For management aerosol contamination from the operative site, there are two approaches:

1) Using devices that remove the contaminated material from the air of the treatment area after it has become airborne

Ventilation-a standard approach to the control pathogenic bioaerosol transmission is the use of ventilation which dilutes the concentration of droplets in the air by removing the circulating droplets via air exchange. With perfect mixing, 63% of airborne droplets can be removed by each air exchange.The most frequently mentioned methods of removing airborne contamination from the air of the treatment room are the use of two types of air purification systems- high-efficiency particulate air (HEPA) filterand the use of ultraviolet(UV)chambers in the ventilation system. High-efficiency particulate air filters can remove -99.99% of airborne particles through the filter.[19]Irradiation with a lamp emitting ultra-violet radiation 250-265 nm(UV-C) especially the light of 254nm wavelength, shows a very high fungicidal, viricidal and bactericidal action through the destruction of DNA chain and protein denaturation.

Limitation: They are both expensive and these approaches also have the problem that it takes an extended period for the air in the treatmentroom to cycle through the filter or UV treatment system.

2) To remove the airborne contamination before it leaves the immediate area surrounding the operative site.

The use of a high-volume evacuator has been shown to reduce the contamination arising from the operative site by more than 90 percent [5].

Water unit:

The quality of waterflowing from unithandpieces should be monitored in order to determine the number of heterotrophic microflora in potable water and various water decontamination methods may be used.

Correct maintenance of handpiece and dental set-up

Sterilization of handpieces will ensure their internal and external sterility by eliminating a)patient-patient infection and b)contamination of waterlines with tissue fragments and microorganisms [1]. Further, routine bioaerosol monitoring of the dental environment including the surface of instruments and devices, air and dental unit water, and in the case of their contamination – the need for sterilization and disinfection. is recommended to track and control infections as well as for surveillance for infection control [2].

Patient protection against aerosols

The aerosol peaks seemed to reduce to the background levels within 10 and 30 minutes caused by rapid deposition ofparticles after aerosol generation, thus the risk to the subsequent patient in the operating room will be almost entirelyeliminated if there is a period of 10 and 30 minutes between scaling and the entry of the next patient into the room. Disinfection between patients should be done, making sure to extend it to all contaminated areas. Caution is especially advised when treating patients undergoing immunosuppressive or prolonged antibiotic and/or corticosteroid therapy since these patients are susceptible to infections caused by microorganisms that are considered to be nonpathogenic to healthy individuals.

CONCLUSION

T Previous research done by Harrel and Molinari suggests that practitioners should also assume that all patients have infectious diseases potentially spread by aerosol and that this concept should be included as part of the profession's understanding of universal precautions. The dental team should not rely only on a single precautionary strategy but use a layered approach. According to the Center for Disease Control(CDC), guidelines for infection control in dental healthcare settings(2003) consist of dental staff protective equipment (gown, mask, gloves, eyeglasses), preprocedural patient mouth rinsing with antimicrobial products like chlorhexidinegluconate, operatory site isolation(rubber dam), vacuum, air circulation methods (ventilation and air-conditioning systems), air filtration systems for solid particles and mercury, disinfectants or organic compounds vapors, ultraviolet lamps, and microbial controls for instrument and surfaces. So, a few modifications in the way we practice dentistry can help make it a safer place for the dentist, the dental staff and the patient.

REFERENCES

1. Zemouri, Charifa, Soet Hans de, Crielaard Wim, and Laheij Alexa. "A scoping review on bio-aerosols in healthcare and the dental environment." PloS one 12, (2017): e0178007.
2. Szymanska, Jolanta. "Dental bioaerosol as an occupational hazard in a dentist's workplace." Annals of Agricultural and Environmental Medicine 14, (2007):5-8.
3. Bennett, AM, Fulford MR, Walker JT, and Bradshaw DJ, et al. "Microbial aerosols in general dental practice." British dental journal 189, (2000): 664-667.
4. Kobza, J, Pastuszka J, and Brągoszewska E. "Do exposures to aerosols pose a risk to dental professionals?." Occup Med 68, (2018): 454-458.
5. Harrel, Stephen K, and Molinari John. "Aerosols and splatter in dentistry: a brief review of the literature and infection control implications." J Amer Dent Assoc 135, (2004): 429-437.