An Insight on UVC Disinfection and COVID-19

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Received 20 August 2021; **Accepted** 03 September 2021; **Published** 10 September 2021

Abstract

Throughout the current appalling calamity, the fight against COVID-19 has been mostly focused on the disinfection of commonly touched surfaces and personal protective equipment. UV radiation, along with chemical disinfectants, have been utilized extensively as a no-contact automated disinfection technique to disinfect surfaces in public transport systems such as airplanes, as well as patient rooms and operating theatres in hospitals, etc. This mini review provides an insight to the effective use of UVC in limiting the spread of SARS-Cov-2 along with its health hazards due to overexposure.

Keywords: SARS-CoV-2 • Sterilisation • UVC decontamination

Description

Since March 11, 2020, COVID-19 has been spreading horror across the globe and is affecting the economic, psychosocial, and social lives of all. Despite extensive efforts to contain the spread of the disease, the virus is mushrooming egregiously due to its multiple modes of transmission. Airborne route being the most appalling as SARS-CoV-2 is viable in aerosols for hours and be carried over longer distances [1]. Thus, to limit the spread, the routes of transmission need to be blocked. In this regard, the people are advised to follow basic guidelines such as, frequent hand washing, using disinfectants, following cough etiquette, and using facemask. However, the efficacy of these preventative actions is limited, particularly in indoor environments where bio-contaminated circulating air or frequently touched surfaces can mediate transmission [2]. Therefore, practical mitigation technologies are highly desirable and UV radiation has been suggested to be able to inactivate different viruses, including SARS-CoV. Various public places with different levels of contaminated air and surface probabilities, from hospitals and health care facilities to restaurants and cafeterias, started using UV surface disinfection systems [2]. However, limited understanding of the critical aspects of UV disinfection, not only among the majority of general public but also with some of the UV surface disinfection manufacturers, has led to inappropriate use of this promising technology. This mini review provides an insight to the effective use of UVC in limiting the spread of SARS-Cov-2.

UVC disinfection

UV disinfection has been used for the disinfection of pathogens on surfaces, as well as in air and water, for several decades [3]. A particular spectrum of UV radiation between 200 and 280 nm, the so-called UVC spectrum, has been employed extensively as the germicidal range of UV radiation. The direct absorption of the UV-C photon by the nucleic acid basis cause critical damage to the genomic system of microorganisms preventing them for replicating and inactivating [4,5]. Different UVC sources have been utilized such as cold cathode germicidal UV lamps, hot cathode germicidal UV lamps, slim line germicidal UV lamps, high output germicidal UV lamps, UV LEDs, and UV lamp shapes with lamp connectors. However, while the germicidal lamps can be used to disinfect unoccupied spaces, direct exposure to conventional germicidal lamps in occupied public spaces is not possible since direct exposure to these lamps wavelengths can be a health hazard, both to the skin and eyes [6]. By contrast far-UVC light (207 to 222 nm) has been shown to be as efficient as conventional germicidal UV light in killing microorganisms and do not cause the human health issues as associated with germicidal lamps [7]. This wavelength can be generated by excimer lamps which can be deployed in occupied public locations. It is very strongly absorbed by proteins through the peptide bond, so its ability to penetrate biological materials is very limited. This limited penetration is still much larger than the size of viruses and bacteria, so far-UVC light is as efficient in killing these pathogens as conventional germicidal UV light [7].

Efficacy of UVC

The CoV family has been extensively studied and their response to UVC radiation is well-established. The susceptibility of COVID-19 for UVC has not yet been specifically evaluated, and the dose required to inactivate Sars-CoV-2 is still a predicament (about 30 mJ/cm 2 to 108 mJ/cm 2) [2,8]. Various genomic studies suggests that the CoV family is likely more sensitive to UV inactivation than the MS2 virus [9,10]. Testing of an ongoing pathogenic microbe, such as the SARS-CoV-2, could be challenging due to the required biosafety level precautions. Additionally, even if the UV disinfection device is validated to be 99.9% effective against the microorganism, if the initial concentration of the microbe is very high, the remaining 0.1% might be sufficient to cause illness [11].

Safety measurements

Overexposure to UVC may cause harm to human skin/eyes with some consequences occurring acutely and others in a delayed manner. One of the most common acute symptoms is of sunburn [6]. The risk of skin cancer is heavily influenced by UV exposure and skin pigmentation. Moreover, several adverse effects to eyes include photokeratitis, erythema of the eyelid, cataracts, solar retinopathy, and retinal damage. It may also cause irritation to the airway due to the generation of ozone from UVC lamps [11]. Hence, providing a comprehensive operation manual with the product is necessary for UV surface disinfection units.

Conclusion

Lockdown and quarantine alone may not be sufficient to prevent the spread of COVID-19; thus, in addition to conventional preventive measures, innovative disinfection technologies, including UV radiation, grabbed tremendous attention.

References

1. Morawska, L & Cao, J. "Airborne transmission of SARS-CoV-2: The world should face the reality". *Environ. Int*. 139 (2020):105730.
2. Biasin, M., et al. "UV-C irradiation is highly effective in inactivating SARS-CoV-2 replication". *Sci. Rep*. 11.1(2021):1-7.

3. Kowalski,W. "Ultraviolet Germicidal Irradiation Handbook: UVGI for Air and Surface Disinfection". *Springer*. Berlin Heidelberg.2009.

4. Qiao, Z, & Wigginton, KR. "Direct and indirect photochemical reactions in viral RNA measured with RT-qPCR and mass spectrometry". *Environ Sci Technol*. 50.24(2016):13371-13379.

5. Conner-Kerr, TA, et al. "The effects of ultraviolet radiation on antibiotic-resistant bacteria in vitro". *Ostomy Wound Manag*. 44(1998):50-56.

6. Gupta, H., et al. "Accidental Exposure to Ultraviolet-C (UVC) Germicidal Lights: A Case Report and Recommendations in Orthodontic Clinical Settings". *J Indian Orthod Soc*. 55.3(2021).

7. Buonanno, M., et al. "Far-UVC light (222 nm) efficiently and safely inactivates airborne human coronaviruses". *Sci. Rep*.10.1 (2020): 1-8.

8. Heilingloh, CS., et al. "Susceptibility of SARS-CoV-2 to UV irradiation". *Am J Infect Control*. 48.10(2020):1273-1275.

9. Saknimit, M., et al. "Virucidal efficacy of physico-chemical treatments against coronaviruses and parvoviruses of laboratory animals". *Exp Anim*. 37.3(1988):341-345.

10. Kowalski, WJ. "SARS Coronavirus UV Susceptibility". Aerobiological Engineering Report. 2015.

11. Raeiszadeh, M & Adeli, B. "A critical review on ultraviolet disinfection systems against COVID-19 outbreak: Applicability, validation, and safety considerations". *Acs Photonics*.7.11(2020):2941-2951.

Cite this article: Gupta H, Kaur H, Mahajan P, Singh G. An Insight on UVC Disinfection and COVID-19.Med RepCase Stud, 2021,06(5),223