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Archives of Dentistry Editorial

Photodynamic Therapy for the Prevention of SARS-CoV-2 Infection in Dental Office: Could be Possible?

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Received date: September 17, 2020, **Accepted date:** October 29, 2020

Keywords: SARS-CoV-2 in dentistry, Photodynamic therapy, PDT for SARS-CoV-2, Methylen Blue for SARS-CoV-2

In January 2020, the World Health Organization (WHO) identified a novel coronavirus SARS-CoV-2 in the Wuhan province of China, which has since caused a worldwide pandemic, with more than 21.2 million confirmed cases and over 760,200 confirmed deaths as of 14 August 2020. SARS-CoV-2 is a single-stranded RNA virus classified in the family Coronaviridae [1].

Various devices have been proposed for the prevention and treatment of this infections, including the use of laser and non-laser lights [2]. If you insert the keywords “SARS CoV 2 Photodynamic therapy” on the PubMed search engine, however, you will only get 4 results, some more articles can be found with the Google Schoolar search engine. Photodynamic therapy (PDT) could be used for treatment of infections and also it is proposed in cancer and pre-cancerous lesions. Antimicrobial PDT consists mainly in the use of a photosensitizer, which binds selectively to fungal, viral, and bacterial cells, and of a light with a specific wavelength that activates it, in the presence of oxygen. For the mentioned reason it can be considered highly safe [3]. Some studies have speculated that it may be useful in managing this pandemic, as it has already been shown its effectiveness against other influenza viruses [4,5].

A study showed that the PDT treatment of viruses induces the glycoproteins removal from the viral surface and virus become virions non-infectious, and thus without damage to the membrane [4].

PDT was proposed in the decontamination of products infected by microorganisms and blood, mainly in the sterilization of instruments also in surfaces contaminated by viruses such as SARS-CoV-2 [4].

An *in vitro* study evaluated the ability of methylene blue associated with blue light for 40 minutes in inactivating SARS-CoV-2, showing it to be superior to methylene blue alone or light not in combination with the dye [6]. What is surprising about this study is that methylene blue is most frequently associated with wavelengths around 660 nm and therefore with non-blue lights [7]. However, a study has also shown that methylene blue can be a valuable aid in the treatment of respiratory symptoms due to influenza viruses, and PDT in a broad sense could be applied in the treatment of various lung diseases, including carcinoma [8]. As SARS-CoV-2 affects mainly the lower respiratory system, it is relatively easy to irradiate these internal organs endoscopically using an optical fiber. This can be introduced through the nose, suggesting that PDT can mediate the inactivation of the virus in the lungs [8]. Other researchers observed that to reduce viral load, illumination of the target lung tissue using fiberoptic catheter to deliver low-power light of a characteristic absorption wavelength for the photosensitizer (typical range 450–800 nm), causes photoactivation yielding a highly reactive oxygen species capable of destroying the bonded SARS-CoV-2 virions to the photosensitizer molecules through peroxidation [9].

A work evaluated the use of different photosensitizers, including curcumin and vitamin B12, for release into the bloodstream, and subsequently activated by external lights. However, blue light has a poor ability to penetrate internal tissues, while wavelengths around 810 nm are the most effective [10]. The type of photosensitizer to be used in this case would be indocyanine green, a drug already used in the medical diagnostic field [10].

In light of this, it must be said that however the concentration of this virus in the plasma is quite low. Red LED lights at 630 nm, at a dosage of 30 J/cm², have proven effective against MERS CoV, Ebola virus and SARS-CoV-1 [11]. Researchers have then highlighted how ultraviolet

also have important antiviral capabilities, and among these those with a wavelength lower than 200 nm do not appear to be harmful to the skin or other body areas [11].

Photodynamic therapy for the treatment and prevention of this pandemic could be a valid way to go, it is important to identify the most performing parameters. It could be used to decontaminate the patient's mouth prior to dental procedures to prevent the spread of infections.

PDT has been shown to be very useful in treating various infections in the dental field. A systematic review of the literature has highlighted its effectiveness in the periodontal, endodontic, preventive field against dental caries, and in the treatment of various pathologies of the oral mucosa including oral candidiasis [12]. In a case report PDT showed good result in Afta major therapy [13].

Effectiveness in the treatment of oral HSV is documented in a recent review, most studies cited in this work used methylene blue as a photosensitizer, while one used 5-aminolevulinic acid [14].

Dentists are among the most at-risk categories in the medical field, and several aids such as 1% hydrogen peroxide or povidone-iodine rinses, and the use of the rubber dam, have been used to reduce the spread of the virus [15], but the rate of transmission in the dental office is still high [16]. My proposal for the world of scientific research is if it could be possible combining ultraviolet light treatment, given the very easy availability, with a specific dye, to obtain a new type of photodynamic therapy, the UV-PDT in the prevention of SARS-CoV-2 spread.

Figure 1: Photodynamic therapy for the treatment of an Afta minor performed with red light (660 nm of wavelength) and Methylene Blue as a photosensitizer.

Figure 2: Photodynamic therapy in a case of palate chronic candidiasis related to oral prosthesis performed with blue light (460 nm of wavelength) and curcumin as a photosensitizer.

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