Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

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Alternative therapies for Covid-19

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ABSTRACT

Recently, the outbreak of COVID-19 caused serious global health issues and the world is facing a crisis of antiviral resistance. To overcome the crisis, we reviewed the existing therapies that could be an alternative and effective treatment for COVID-19. Therapies such as ozone, laser, UV radiation and radiation therapy are discussed and the mechanism of killing is elaborated. In conclusion, the ozone, laser and radiation therapy could be considered as an alternative therapy in extirpating the coronavirus from bloodstreams and the challenges in bringing these therapies to clinical trials.

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1. Introduction

The outbreak of Coronavirus disease (COVID-19) from Wuhan city, China has become a global public health concern and World Health Organization (WHO) has declared it a public health emergency. COVID-19 is an emerging and rapidly spreading disease across the world and WHO declared it as a pandemic. As on March 2021, more than 160 million people were affected and over 3.5 million deaths were recorded [1]. To combat the COVID-19 several scientists have joined hands and rapid research is in progress to develop a vaccine and prolific drug to fight against COVID-19. Development of a vaccine is a time-consuming process and requires regulatory approvals and extensive clinical trials to prove its efficacy. Several drugs have been proposed by various research and development labs and the clinical trials are underway. At this point of emergency, social distancing and quarantine are best practices to fight against COVID-19. Despite the interest in developing antiviral drugs and alternative approach to treat this infectious disease is urgently needed. Considering the challenges, the existing therapies to kill the viruses using various sources such as Ozone [2], Laser [3], UV irradiation [4] and Radiation therapy [5] are discussed. An evidenced based review on Ozone therapy for COVID patients is reported by Cattel et al., [6] and similarly photodynamic therapy administered for mild to moderate COIVD patients are also reported by Khorsandi et al., [7].

2. Alternative therapies

2.1. Ozone therapy

Ozone (O_3) a naturally occurring gas molecule has tremendous proven medicinal applications. Ozone therapy has successfully used as antibacterial, anti-inflammatory and it is capable of treating more than 114 diseases [8,9]. Ozone therapy was successful in treating HIV patients along with autohemotherapy [10]. Ozone is effective in disrupting the bacterial cell envelope through oxidation of the lipoproteins and phospholipids and inhibits cell growth at a certain stage of fungi. Ozone plays a predominant role in inactivating the virus by damaging the capsid and upsetting the virus to cell contact by peroxidation [2].Ozone therapy was suggested to be a monotherapy for SARS with its unique physio-chemical and biological properties [11]. Ozone comes out with positive effects on the treatment of viral infections, particularly where antibiotics cannot influence [12]. Ozone therapy can be a better technique for the treatment of COVID-19. The Ozone molecule can diffuse through the protein coat and interact with the viral RNA and damage the nucleic core resulting in the destruction of the virus at low concentrations. At high concentrations, the capsid or protein exterior of coronavirus will be damaged to a greater extent by oxidation. However, the Ozone can also destroy other

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active cells and lead to several disorders and cancer. Hence, progressive investigations on ozone for COVID-19 are further envisaged.

2.2. Laser therapy

Laser therapy is gaining popularity because of its effectiveness in blasting the virus capsid and blocking the mutation by deactivation which is not achieved by other techniques [13]. Ultrashort pulsed laser irradiation is another technique that is used to inactivate the virus capsid by irradiating the virus for femtoseconds [3]. The results showed no replication, internalization or gene expression of viral after laser inactivation. Continual studies suggest that laser therapy has the possibility of cleansing blood samples with virus and pathogens by combining with blood dialysis treatments [14]. The lasers have a tendency to inactivate virus that could help in combating the drug resistant COVID-19 and cease the viral replication.

2.3. UV radiation

UV radiation from the sun is considered to be the primary germicide of the environment which inactivates a variety of viruses with double and single-stranded DNA and RNA genomes [15]. Exposure to UV radiation chemically modifies the DNA or RNA genome of the virus and kills it effectively [15]. Estimating the suitable wavelength (nm) of UV interacting and modifying the DNA or RNA genome of the viruses is essential. The nucleic acids absorb UV radiation and inactivates virus compared to other components of the virus [16]. UV radiation (254 nm) is predominant in inactivating DNA genome rather than RNA genome due to absence of thymine in the later genome [17]. Since the COVID-19 is due to RNA genome enveloped virus, the UV radiation might not be predominant technique in inactivating the coronavirus and research investigations will unfold the merits of this technique. However, the major disadvantage of UV radiation is it destroys the adjacent cells and leads to cancer and thus limits the application of UV radiation in virus inactivation.

2.4. Radiation therapy

Radiation therapy is one of the most promising therapies for cancer treatment, blood disorders, thyroid disease and noncancerous growth. Radiation treatment uses radioactive substances that are given in the vein or mouth. Radiation produced by the radioactive substances kills the cells and is particularly effective at killing rapidly dividing cells. Radiation therapies are effective at low doses with local control and the toxicity increases at higher doses [5]. Ionizing radiation is employed in decreasing the infectivity of viruses by bombardment technique [18]. In many cases, radiotherapy has been successfully employed in treating leukaemia and other blood cancers by destroying the abnormal and infected blood cells. Total body irradiation (TBI) was suggested as one of the potential methods to treat Ebola virus infection [19]. Radioimmunotherapy (RTI) is another promising technique which is used effectively to eradicate HIV infected cells. RTI and TBI are found to be effective therapies however; the side effects limit the dose that is ineffective.

Recent investigations and observations on fatality from China, Italy, Spain and the USA suggest that the patients infected with COVID-19 die predominantly due to severe hypoxaemia resulting in organs failure [20]. Hypoxaemia is due to loss of the ability of heme to bind oxygen when the SARS-COV2 virus attach to heme. When the heme loses its ability to bind oxygen, the organs do not get delivered the required amount of oxygen to function and just stop functioning. Hence, aborting binding of SARS-COV2 onto heme is essential and techniques such as ozone and laser therapy can be effective on inactivating the SARS-COV2 from further replication in the blood streams.

3. Conclusion

The outbreak of COVID-19 has caused perilous situation globally and research is spearheading towards development of vaccines. It well known that the developments of vaccines are time consuming and undergoes rigorous approval process and it must be desirable to have other treatment techniques in practise to combat the COVID-19 pandemic. Therapies such as ozone therapy, laser therapy and radiation therapy might be effective in dealing with COVID-19 pandemic. The Ozone therapy can destroy the capsid of SARS-COV2 and inactivate it in the blood stream and laser therapy can also prolifically inactivate the coronavirus. Considering the recent cases, it is better to have alternative treatments as options to possibly fight against the COVID-19. Alternative treatments can unfold infectious disease and can be a better solution for COVID-19. Further, research is required to investigate the SARS-COV2 virus and radiation interactions.

CRediT authorship contribution statement

G. Sundararajan: Data curation, Resources. **Prince J. Isaac:** Writing original draft. **Andal:** Writing- review and editing. **Lakshmipathy:** Conceptutilization, Supervision.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

[1] World Health Organisation. Coronavirus disease (covid-2019) situation reports; 2020 (Accessed on September 11 2020).
[2] A.M. Elvis, J.S. Ekta, Ozone therapy: a clinical review, J. Nat. Sci. Biol. Med. 2 (1) (2011) 66–70, https://doi.org/10.4103/0976-9668.82319.
[3] S.W. Tsen, T. Chapa, W. Beatty, B. Xu, K.T. Tsen, S. Achilefu, Ultrashort pulsed laser treatment inactivates viruses by inhibiting viral replication and transcription in the host nucleus, Antiviral Res. 110 (2014) 70–76, https://doi.org/10.1016/j.antiviral.2014.07.012.
[4] M.M. Jensen, Inactivation of airborne viruses by ultraviolet irradiation, Appl. Microbiol., Vol 12 (5), 418-420.
[5] P.S. Adusumilli, B.M. Stiles, M.-K. Chan, T.-C. Chou, R.J. Wong, V.W. Rusch, Y. Fong, Radiation therapy potentiates effective oncolytic viral therapy in the treatment of lung cancer, Ann. Thorac. Surg. 80 (2) (2005) 409–417, https://doi.org/10.1016/j.athoracsur.2005.01.048.
[6] F. Cattel, S. Giordano, C. Bertiond, T. Lupia, S. Corcione, M. Scaldaferri, L. Angelone, F.G. De Rosa, Ozone therapy in COVID-19: a narrative review, Virus Res. 291 (2021) 198207, https://doi.org/10.1016/j.virusres.2020.198207.
[7] K. Khorsandi, S. Fekrazad, F. Vahdatinia, A. Farmany, R. Fekrazad, Nano antiviral photodynamic therapy: a probable biophysicochemical management modality in SARS- CoV-2, Expert Opin. Drug Deliv. 18 (2) (2021) 265–272.
[8] L. McLean, The miracle of ozone therapy. Available from: http://www.zeusinfoservice.com/Articles/TheMiracleofOzoneTherapy.pdf.
[9] G. Stoker, Ozone in chronic middle ear deafness, Lancet 160 (4131) (1902) 1187–1188.
[10] M.T.F. Carpendale, J.K. Freeberg, Ozone inactivates HIV at noncytotoxic concentrations, Antiviral Res. 16 (3) (1991) 281–292.
[11] G.V. Sunnen, 2003, SARS and ozone therapy: theoretical considerations.
[12] P. Shah, A.K. Shyam, S. Shah, Adjuvant combined ozone therapy for extensive wound over tibia, Indian J. Orthop. 45 (4) (2011) 376–379.
[13] K.T. Tsen, S.-W. Tsen, O.F. Sankey, J.G. Kiang, Selective inactivation of microorganisms with near-infrared femtosecond laser pulses, J. Phys.: Condensed Matter, Nov. 28, 2007, 472201.
[14] A. Sabbaghi, S.M. Miri, M. Keshavarz, M. Zargar, A. Ghaemi, Inactivation methods for whole influenza vaccine production, Rev. Med. Virol. 29 (e2074) (2019), https://doi.org/10.1002/rmv.2074.
[15] C.D. Lytle, J.L. Sagripanti, Predicted inactivation of viruses of relevance to biodefense by solar radiation, J. Virol. 79 (22) (2005) 14244–14252, https://doi.org/10.1128/JVI.79.22.14244-14252.2005.

[16] A.M. Rauth, The physical state of viral nucleic acid and the sensitivity of viruses to ultraviolet light, Biophys. J. 5 (3) (1965) 257–273.
[17] T.M. Murphy, M.P. Gordon, Photobiology of RNA viruses, in: H. Fraenkel-Conrat, R.R. Wagner (Eds.), Comprehensive virology, Plenum Press, New York, N.Y, 1981, pp. 285–351.
[18] E. Pollard, The action of ionizing radiation on viruses, Adv. Virus Res. 2 (1954) 109–151.
[19] W.F. Ngwa, R. Teboh, C.G. Orton, Point/counterpoint. Radiotherapy is an appropriate treatment to consider for patients infected with the Ebola virus, Med. Phys. 42 (3) (2015) 1149–1152, https://doi.org/10.1118/1.4903900.
[20] J. Vincent, F.S. Taccone, Understanding pathways to death in patients with COVID-19, Lancet Respir. Med. 8 (5) (2020) 430–432.