Use of the MLS® Laser Therapy in the management of SARS-CoV-2 infection: a case report

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INTRODUCTION

COVID-19 (Coronavirus Disease 2019) is a viral disease caused by the infection of an RNA virus, SARS-CoV-2 (Severe Acute Respiratory Syndrome CoronaVirus 2). Since the first cases in Wuhan at the end of 2019, SARS-CoV-2 has spread rapidly to many countries around the world causing a global health emergency. Indeed, its high speed of propagation and the various forms of contamination led the World Health Organization to declare a pandemic on March 11th, 2020 [1]. Most COVID-19 patients are asymptomatic or show mild symptoms, such as cough, fever, anosmia and ageusia: in these instances, patients usually do not need hospitalization [2]. However, the outcome of COVID-19 is often unpredictable, especially in elderly patients or patients who present comorbidities (obesity [3] or diabetes [4], for example).

Typically, the longer the symptoms persist, the greater the risk of developing a more severe form of COVID-19, which could lead to hospitalization, invasive mechanical ventilation and, consequently, admission to intensive care units. Common complications include cardiovascular events, acute respiratory distress syndrome (ARDS) and a condition of excessive inflammation referred to as a "cytokine storm" [5,6,7]. Since 2019, the SARS-CoV-2 infection and its consequences has led to the death of more than 3,9 million of people, to hospital overcrowding, to increased costs for national health systems and to a critical condition not only in the medical environment, but also in the social, economic, and cultural fields.

Since SARS-CoV-2 activates alveolar macrophages and neutrophils causing inflammation and vascular permeability, one of the most problematic effects of COVID-19 infection is the excessive production of pro-inflammatory cytokines, which can damage the lung structure and can also spread to other organs, damaging them [8]. Therefore, it seems crucial to find a targeted therapy able to modulate the immune system and control inflammation. Currently, the most common protocols for treating COVID-19 involve different types of drugs and different strategies (Hydroxychloroquine, antivirals such as Remdesivir, or immunomodulatory therapies with interferon, e.g.). Numerous clinical trials are underway, but so far, no therapy has been shown to be targeted and fully effective against the symptoms caused by the virus infection [9].

An emerging strategy that could help modulating the inflammatory response in COVID-19 patients is photobiomodulation therapy (PBMT). It is an adjunctive therapy already used in various fields, such as wound healing [10], musculoskeletal pain [11], asthma [12], etc... where it has already proven to exert a significant anti-inflammatory action. PBMT involves the use of non-ionizing, non-thermal light sources in the visible and infrared spectra (400-1000 nm) that are absorbed by intracellular chromophores and promote a cascade of intracellular reactions promoting the healing process in the tissue [13]. There are various recent studies and systematic reviews that show the beneficial effect of PBMT in the treatment of COVID-19 patients [14,15,16]. Moreover, PBMT is a non-pharmacological, non-invasive and inexpensive therapy and has not shown adverse side effects. This case report describes the application of a Multiwave Locked System (MLS®) laser in the management of a COVID-19 patient.

CASE DESCRIPTION

The patient is a 70-year-old man who was admitted to the hospital (standard department) on Feb. 7th 2021 with symptoms of respiratory failure, cough, gagging and chest pain, and radiographic evidence of atypical COVID-19 pneumonia (presence of bilateral multifocal consolidations; presence of interstitial infiltrates – associated or not with alveolar infiltrates – with predominantly bilateral and basal distribution; ground glass opacities in the periphery of both lungs in the mid and lower zones). At his arrival, the oxygen saturation level (SpO2) was 90% (free air). Ferritin level was 1500 ng/ml. On Feb. 9th 2021 the oxygen saturation level was 95% (2l O2/min); on the same day, the patient started laser therapy. During the hospitalization the patient received the following pharmacological therapy:

Antibiotics: cephalosporin (Sefotak) 1g, intravenously, three times a day
Corticoids: Dexamethasone 8 mg, intravenously, once a day
Anticoagulants: Heparin (Fraxiparine) 0,6 ml, subcutaneously, twice a day
Antitussives: Codein, 30 mg, orally, once a day Probiotics: Linex forte, 25 mg, orally, once a day
Mucolytics: Ambrobene, 30 mg, orally, twice a day Aldosterone antagonists: Verospiron, 25mg, orally, once a day, as needed Infusion (Plasmalyte) 1000 ml, intravenously, once a day, as needed A Multiwave Locked System laser (MLS®-M6, ASA S.r.l., Vicenza, Italy) was used to perform the PBMT.

It is a class IV NIR laser with two synchronized sources: the first one consists in three GaAlAs laser diodes emitting in continuous or continuous-interrupted mode at 808 nm, maximum power of 1 W for each diode, frequency of 1-2000 Hz, duty cycle of 50%; the second source consists in three superpulsed GaAs laser diodes emitting in pulsed mode at 905 nm, peak power 25 W, pulse duration of 100 ns, modulated with train of pulses synchronized with the 808nm component.

For the treatment the device settings was: frequency 1500Hz, duty cycle of 50%, 100% Intensity (average power of 2W). The scanner with spot size of 20cm^2 was positioned 20 cm above the skin, according to the manufacturer's instructions. Each lung was scanned for 14 minutes and 40 seconds, from apex to base, over an area of 250 cm^2 of the posterior thorax, resulting in 29 minutes and 20 seconds of treatment with a dosage of 7.1 J/cm^2 and a total energy of 3550 J.

The patient received once-daily treatments on 5 consecutive days. The patient was treated in the prone position with hands under the head for maximal scapular protraction to reduce the muscle and bone barrier and improve laser penetration.

At the end of the therapy, oxygen saturation level and ferritin level were 98% (free air) and 597 ng/ml, respectively.

From the chest radiography, a reduction of inflammation was evident. Both lungs appeared clear and expanded with no infiltrates. Reduction of consolidation and ground glass opacities were reported.

Date	Feb. 7th 2021	Feb. 9th 2021
Clinical course	The patient (70-year-old) was admitted to the standard department with manifestation of respiratory failure and radiographic evidence of covid pneumonia.	Start MLS® Laser Therapy (I treat)
Level of saturation	90% (free air)	95% (2l O2/min)
Ferritin level	1500 ng/ml	

Date	Feb. 10th	Feb. 11th	Feb. 12th	Feb. 13th	Feb. 15th 2021
Clinical course	MLS® (II)	MLS® (III)	MLS® (IV)	MLS® (V)	The patient was released in good general condition, by ventilating freely in the air for home care
Level of saturation					98% (free air)
Ferritin level					597 ng/ml

Figure 1:
Chest Radiography of the patient (8th Feb. 2021).

Figure 2:
Chest Radiography of the patient (15th Feb. 2021).

DISCUSSION

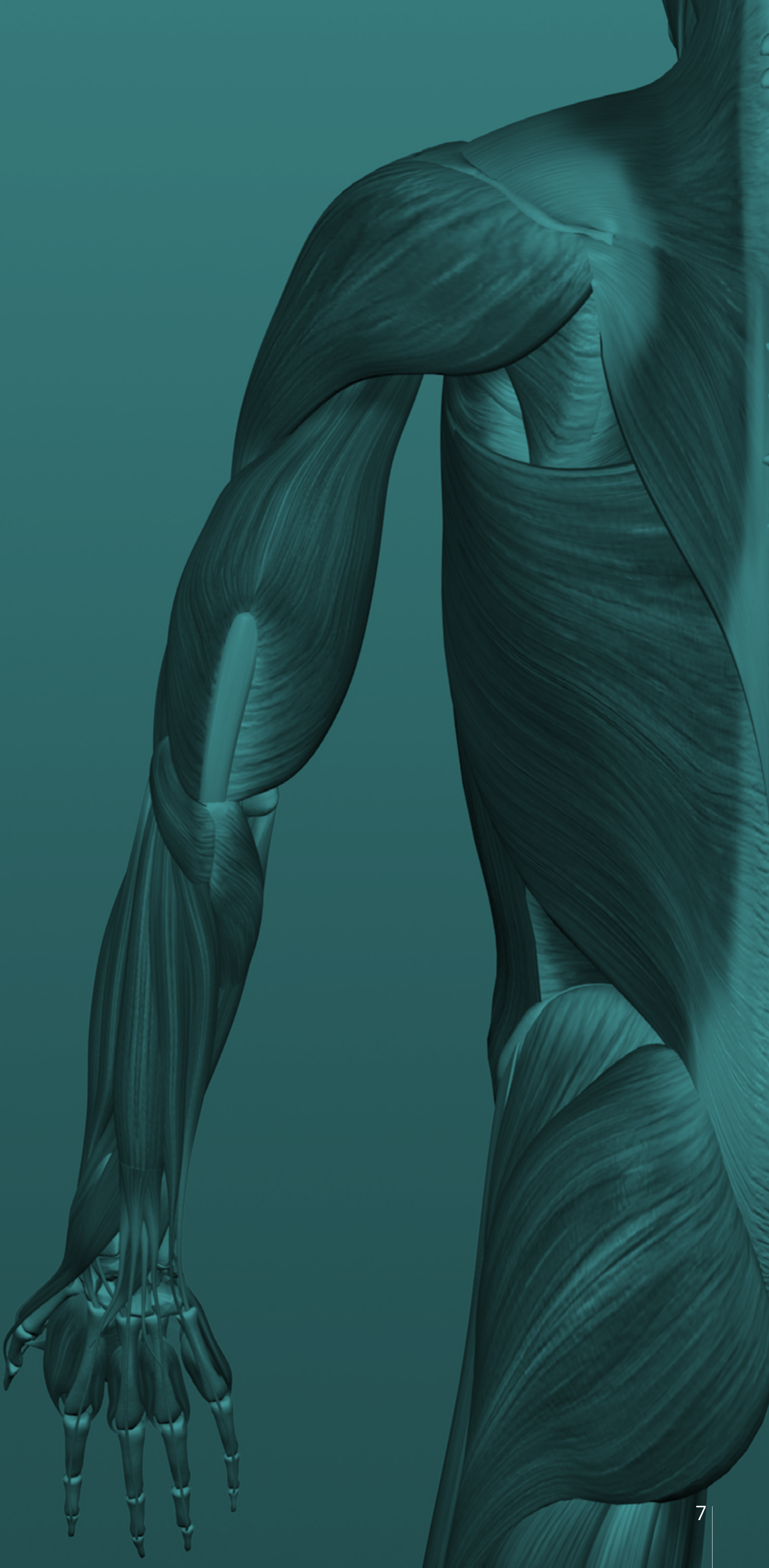
The clinical case mentioned in this study clearly indicates a positive effect of MLS® laser therapy in a patient with severe COVID pneumonia, symptoms of respiratory failure, cough, gagging and chest pain. The treatment was started in the very first days of hospitalization in order to effectively control the evolution of the inflammatory response. When the patient was admitted to the hospital, the oxygen saturation level (SpO2) was 90% (free air) and it was 95% (2l O2/min) on February, 9th, the day that the patient started the MLS® laser therapy. After 5 days of therapy, the results showed a significant increase of the oxygen saturation level, which improved to 98% (free air) and a positive effect of the therapy in improving the health status of the patient, with regression of symptoms. Furthermore, a ferritin blood test was performed on the patient before and after the MLS® laser therapy: the results showed a decrease in ferritin level from 1500 ng/mL to 597 ng/mL. Serum ferritin is widely recognized as an acute phase reactant and marker of acute and chronic inflammation. Higher ferritin levels have been described in Covid-19 patients with more severe disease and deceased [17,18]. Therefore, it is plausible that ferritin may be one of the useful parameter to predict disease severity and the extent of the inflammation. Even though 597 ng/mL is higher than normal, the results showed a significant decrease in ferritin level after MLS® laser therapy. Lastly, a radiographic control was performed before and after laser therapy: a significant improvement was appreciable after the 5 laser treatments.

CONCLUSION

Although related to only one patient, the outcomes of this study support the use of MLS® Lasertherapy as useful and promising therapy for the management of patients with COVID-19 pneumonia. Furthermore, it is an almost non-invasive form of therapy, with no significant side effects, that can be used as a complementary treatment of the standard drug therapy. MLS® laser therapy has the effect of relieving the acute inflammatory manifestations of the so-called cytokine storm, promoting the recovery of damaged lung tissues. It shortens the hospitalization, which translates into a lightening of the health system.

REFERENCES

1. Jiang F., Deng L., Zhang L., Cai Y., Cheung C.W., Xia Z., "*Review of the Clinical Characteristics of Coronavirus Disease 2019 (COVID-19)*", Journal of General Internal Medicine (2020).
2. Oran D., Topol E., "*Prevalence of asymptomatic SARS-CoV-2 infection: a narrative review*", Annals of internal medicine (2020).
3. Wei-jie Guan et al, "*Comorbidity and its impact on 1590 patients with COVID-19 in China: a nationwide analysis*", European Respiratory Journal (2020).
4. Parag Goyal et al, "*Clinical characteristics of Covid-19 in New York City*", The New England Journal of Medicine (2020).
5. Kuppalli K., Rasmussen A., "*A glimpse into the eye of the COVID-19 cytokine storm*", EBio Medicine (2020).
6. Wang D. et al, "*Clinical characteristics of 138 hospitalized patients with 2019 novel coronavirus-infected pneumonia in Wuhan, China*", JAMA (2020).
7. Bonow R. O. et al, "*Association of Coronavirus disease 2019 (COVID-19) with myocardial injury and mortality*", Jama Cardiology (2020).
8. Ruan Q., Yang K., Wang W., Jiang L. and Son, J., "*Clinical predictors of mortality due to COVID-19 based on an analysis of data of 150 patients from Wuhan, China*", Intensive Care Medicine (2020).
9. Hachfi W., Ben Lasfar N., "*COVID-19: main therapeutic options*", La Tunisie Médicale (2020).
10. Peplow P.V., Chung T., Baxter G.D., "*Laser photobiomodulation of wound healing: a review of experimental*



studies in mouse and rat animal models", Photomedicine and laser surgery (2010).

11. Cotler H.B. et al, "*The use of low-level laser therapy (LLLT) for musculoskeletal pain*", MOJ Orthopedics & Rheumatology (2015).
12. Vatankhah et al, "*Evaluation of the effect of low-level laser therapy (LLLT) in the treatment of asthma, added to conventional drug therapy (crossover, case control clinical trial)*", Photodiagnosis and Photodynamic Therapy, (2008).
13. Hamblin M.R. "*Mechanisms and applications of the anti-inflammatory effects of photobiomodulation*", AIMS Biophysics (2017).
14. Sigman S., Mokmeli S., Monici M., Vetrici M., "*A 57-year-old African-American man with severe COVID-19 pneumonia who responded to supportive photobiomodulation therapy (PBMT): first use of PBMT in COVID-19*", American Journal of case reports (2020).
15. Vetrici M., Mokmeli S., Bohm A., Monici M., Sigman A., "*Evaluation of adjunctive photobiomodulation (PBMT) for COVID-19 penumonia via clinical status and pulmonary severity indices in a preliminary trial*", Journal of Inflammation research (2021).
16. Brenda Thaynne Lima de Matos et al, "*Photobiomodulation therapy ad a possible new approach in COVID-19: a systematic review*", MDPI (2021).
17. Lin, Z. et al. Serum ferritin as an independent risk factor for severity in COVID-19 patients. J. *Infect.* S0163–4453(20), 30434–30435 (2020).
18. Gandini, O. et al. Serum ferritin is an independent risk factor for acute respiratory distress syndrome in COVID-19. J *Infect.* 81(6), 979–997 (2020).