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Case Report

Reduction of Post-Covid Pulmonary Fibrosis and Bronchiectasis by Physiotherapy

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Abstract

SARS COV2 infection causes lung lesions characterized by the appearance of ground glass opacities, and a significant percentage of patient's present persistent symptoms and changes in CT scan represented by fibrotic lesions, traction bronchiectasis, and persistence of ground glass images. Laser therapy has anti-inflammatory effects, stabilizes the vascular endothelium, has antifibrotic effects, being a useful therapy both in the acute phase of SARS COV2 pneumonia, as well as in the post-acute and chronic phase, rapidly reducing the symptomatology and being able to prevent and even to reverse the sequelae. I will present the case to a 65-year-old patient with massive lung damage (75%) who began the recuperative treatment one month after being discharged from the hospital. After the completion of the treatment (MLS laser therapy, shortwave, magnetotherapy and kinetic therapy), patient's condition has improved considerably. A control CT scan performed after 5 months revealed complete remission of arciform and multidirectional fibrotic bands, cvasicomplete remission of the "ground glass"areas, remission of reticular pattern changes in the subpleural fields in the upper lobes and especially in the lower lobes, remission of traction bronchiectasis, dimensional decrease of mediastinal and hilar lymphadenopathy.

Keywords: Lung recovery; MLS Lasertherapy; Magnethotherapy; Photobiomodulation; Postcovid Rehabilitation; SARS COV-2; Short-Wave Diathermy

Introduction

The occurrence in 2019 of SARS COV-2 pneumopathy represented a new medical challenge both in terms of managing the situation in the acute phase of the a (severe acute respiratory syndrome, characterized by a high mortality) and in the post-acute and chronic phase, in which the appearance and progressive evolution of pulmonary fibrosis and traction bronchiectasis is the main problem. In the medium term, it was found that some of the patients with COVID pneumonitis, especially those who had severe forms and required oxygen therapy, have persistent symptoms, the percentage of which varies between 30% in a long-term follow-up study of unhospitalized patients [1] and 53-71% in the studies in which the cohort was made up of patients who required hospitalization [2,3]. Also, on CT scans were found the presence of structural changes in the form of ground glass opacities in and fibrosis. After 6 months of the acute episode, 35% of the patients had fibrotic lesions (bronchiectasis by traction, fibrosis bands or honeycomb image) and 21% still had ground glass opacities. Predictive factors for the occurrence of fibrosis are: respiratory distress syndrome, extensive initial CT changes, noninvasive mechanical ventilation, prolonged hospitalization, age over 50 years [4]. In a spanish study the most common CT findings (at 8-12 weeks after hospital discharge) were bronchialdilation (80%) and parenchymal bands (78%), consisting of elongated opacities 1−3 mm thick in the lung parenchyma, sub pleural in location or extending up to the pleural surface, frequently with distortion of the lung architecture. Other findings identified in more than half of the cases were: coarse subpleural reticulation with irregular interfaces due to architectural distortion, but with no honeycombing (66%); areas of ground-glass opacity (58%), and a mosaic pattern due to air trapping demonstrated in the expiratory phase of the scan (51%), existence of pneumatoceles (14%) [5]. In a prospective

observational study performed in patients who had a critical care admission due to COVID-19 between March and August 2020 in Hospital Universitari Arnau de Vilanova and Hospital Universitari Santa Maria in Lleida (Spain) at 12 month follow-up 40.9 and 70.2% had abnormal TLC (Total Lung Capacity) and DLCO (diffusing capacity for carbon monoxide) values, respectively; the chest CT of these more affected patients showed a high proportion of abnormalities, with the most frequent finding being interlobular septal thickening (100%) and bronchiectasis (90.2%); presence of reticular and fibrotic patterns in 53.7 and 36.6% of patients, respectively; solid nodule (43%) [6].

The persistent respiratory complications may cause substantial population morbidity, longterm disability, and even death due to lung fibrosis progression. The incidence rate of post-COVID lung fibrosis can be estimated at 2–6% after moderate illness. According to this estimation, the prevalence of post-COVID lung fibrosis will be from 10 to 30 patients per 10,000 populations, which is 30 times higher than the idiopatic pulmonary fibrosis prevalence [7]. Under given circumstances, it is important to identify any therapeutic modality that could reduce post-COVID sequelae. One of these ways could be laser photobiomodulation (PBM), with numerous studies demonstrating its anti-inflammatory and antifibrotic effect. PBM reduces protein deposits, alveolar enlargement, production of proinflammatory cytokines (IL-1β, IL-6, TNFα) as well as P2X7 [8]. PBM improves muscle function by reducing oxidative stress and inflammatory cytokines (IL-6 and TNFα), increasing IL-10 [9-11]. PBM reduces neutrophil influx, myeloperoxidase activity, mRNA expression for CAM-1 adhesion molecules, edema, reduces ROS formation, increases glutathione concentration in the lung. Through these actions, PBM reduces the stress that is considerably increased in COVID-19 patients [11]. Furthermore, PBM reduces the exaggerated production of mucus, collagen deposits and the release of cytokines [12,13] can be used as an auxiliary treatment to reduce pulmonary inflation and activate the immune system. PMB is effective in reducing IL-6 levels and increases the CD4+/CD8+ ratio [14]. Several experiments have revealed positive effects of PBM on acute or chronic pulmonary inflammation [8,15] PMB has also been observed to reduce pulmonary fibrosis [16]. There are studies that have demonstrated the antifibrotic role of PBM by lowering the level of TGFβ in fibroblasts and in lung tissue [16]. A recent study clearly demonstrated the effect of PBM in reducing inflammation and post-inflammatory fibrosis [17]. In August 2020, the first case in which laser photobiomodulation was used in the treatment of lung lesions, using a high-power laser with synchronized emission over two wavelengths, was reported. The study was conducted by dr. Sigman, after receiving FDA approval. The results after 4 days of treatment were to improve all the parameters followed [18]. There is also evidence regarding the use of shortwaves [19-21] and magnetotherapy [22-24] in the treatment of acute and chronic lung diseases.

Case Report

65 years old caucasian man with massive pulmonary damage due to SARS-COV-2 infection was hospitalized in October 2021 and treated with corticotherapy (dexamethasone), antiviral medication (remdesivir) and non-invasive oxygen therapy. Presents himself into our clinic one month after discharge from the infectious diseases department with dyspnea at medium efforts, fatigability, and cough. From the background, we retain a "very bad flu" 8 month ago (February 2021), for which he was self-treated at home. CT scan one week after hospital discharge: parenchymal changes in both lung areas, central and peripheral, more important in the bilateral lower lobes, manifested by reticular opacity with thickening of the inter and intralobular septa, irregular bands of fibrosis and traction bronchiectasia, sometimes overlapping ground glass opacity, which occupies ~ 75% of the lung parenchyma, numerous mediastino-hilar lymphadenopathy. The changes of pulmonary fibrosis visible on the CT scan performed shortly after the infectious episode suggest that the "flu" suffered in February 2021 was a SARS-COV2 pneumonia, the patient being actually at the second episode of SARS-COV2 infection. At the initial evaluation in our clinic (November 2021), the patient had normal pulsoximetry (SpO2=95%) and normal spirometry (FVC=84%; VEMS=103%; PEF=108%) (Figure 1).

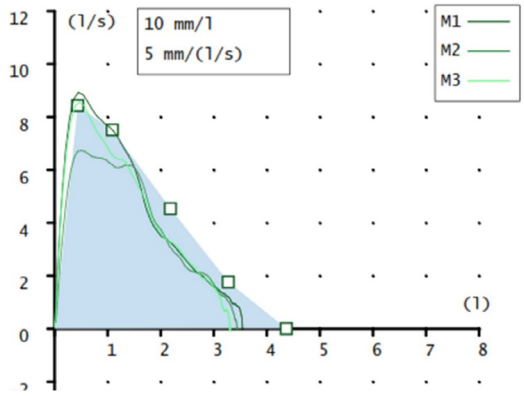

Figure 1: Normal spirometry.

The applied treatment consisted of high-power laser photobiomodulation (MLS laser therapy), pulsating shortwave diathermy, magnetotherapy and kinesiotherapy. For laser therapy, was used a high intensity MLS (Multiwave Locked System) laser device with synchronized laser emission on two wavelengths (808 and 905nm), with a maximum power of 3X75 W, an average power of 3600 mW and a laser spot surface of 20cm2. Exposed areas were represented by the interscapulum-vertebral regions; the duration of the treatment was 14 minutes for each area (28 minutes in total). Patient was in prone position with hands under his head for maximal scapular protraction, through this position ensuring an

optimal penetrability of the laser radiation in the deep tissues. Magnetotherapy was applied in the form of low frequency magnetic fields with rectangular pulses, (pulse duration 15 ms, pause 220 ms), intensity of magnetic field 142 mT, time 30 min. Diathermia was also applied on the interscapulum-vertebral spaces with oligotherme doses (peak power 85W, medium power 10W, frecvency 400Hz), for 15 minutes for each interscapulovertebral space. Physical therapy consisted of exercises to increase the strength of the respiratory muscles, the pulmonary capacity, the increase of the amplitude of the costal excursions and the tolerance to the effort. All this complex treatment was applied daily, for 10 days. During the treatment, it was found the progressive reduction of dyspnea, the decrease of the cough frequency, the reduction of fatiguability, the increase of the tolerance to effort. At 6-month follow-up the patient is free of symptoms and he performed a new CT scan, on the same equipment and interpreted by the same radiologist, which highlighted: complete remission of arciform and multidirectional fibrotic bands, cvasicomplete remission of the "ground glass"areas, remission of reticular pattern changes in the subpleural fields in the upper lobes and especially in the lower lobes, remission of traction bronchiectasis, dimensional decrease of mediastinal and hilar lymphadenopathy. In the interval from the end of the physiotherapy treatment to the control CT scan, the patient did not receive any kind of treatment (neither medicinal, nor recovery) (Figures 2&3).

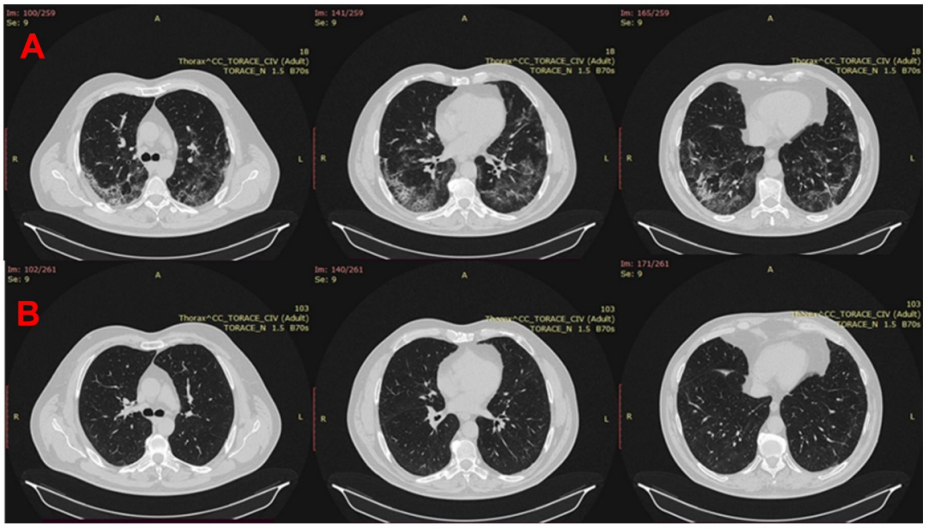

Figure 2: CT image in a patient of 65 years with SARS-COV 2 infection with lung damage 75% before (A) and after treatment (B): obvious favorable evolution of pulmonary and mediastinal changes.

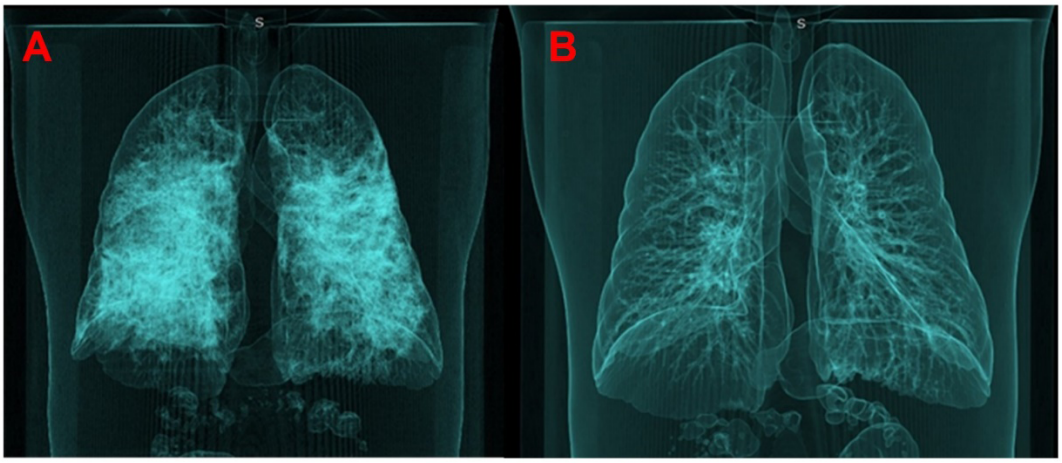

Figure 3: CT scan 3D reconstruction in a patient of 65 years with SARS-COV 2 infection with lung damage 75% before (A) and after treatment (B): obvious favorable evolution of pulmonary and mediastinal changes.

Discussion

The multiple effects, proven by in vivo and in vitro studies, of PBM support the application of this therapeutic method both in the acute period of COVID-19 pneumopathy and in the sequelae period to reduce mortality and morbidity, increase the quality of life and socio-professional reintegration of patients. In fact, an analysis of the studies on PMB in COVID pneumopathy, which included 18 studies from the Pubmed/MEDLINE database, an article from the Web of Science; 3 articles from Google Scholar, which were selected according to rigorous criteria, concluded that PBM represents a promising approach in COVID-19 pneumonitis, having a demonstrated anti-inflammatory effect, which can especially counteract lung damage [25]. Pulsatile shortwave therapy uses the electrical component of the alternating high-frequency electromagnetic field (27.12 MHz). It is used in the period of resolution of the inflammatory process, being applied in the area of the pulmonary pathological focus. This treatment increases local circulation, reduces inflammation, promotes a faster and better healing of lesions, reduces leukocytosis, with an increase in the number of monocytes. Thus, at the lung level shortwave therapy contributes to the reduction of exudative alveolitis, diminishing edema and restoring microcirculation. Under the influence of the high-frequency electromagnetic field, the local phagocytosis is amplified by eliminating cellular debris. Low-frequency magnetotherapy is a therapeutic application of the magnetic component of an alternating low-frequency electromagnetic field. It is prescribed to patients with residual symptoms to reduce edema and improve alveolar blood flow, stimulate metabolic processes in the area of inflammation. The magnetic field has anti-inflammatory effect, trophic effect (by stimulating the cellular metabolism will be accelerated the healing and regeneration process), myorelaxant and spasmolytic effect, vasodilator effect, at the cellular level increases the production of ATP, provides cellular protection by controlling the production of reactive oxygen species. Kinesiotherapy aims to improve alveolar ventilation (increasing the expansion of the chest through techniques to promote ventilation in different pulmonary segments, poorly ventilated or even atelectatic; decreasing ventilatory labor the patient reduces his current volume and increases the frequency of breathing compensatory mechanism of adaptation due to the decrease of pulmonary complacency, through controlled breathing exercises he is taught to counteract this tendency; the increase in the current volume and increases the frequency of breathing compensatory mechanism of adaptation due to the decrease of pulmonary complacency, through controlled breathing exercises he is taught to counteract this tendency; respiratory muscle pump yield) and exercise training is important for increasing peripheral muscle and respiratory muscle performance through better infusion and by increasing the ability to extract oxygen from the blood.

Conclusion

The therapeutic means belonging to physical medicine (MLS laser therapy, shortwaves, magnetotherapy) have been used in the past, empirically, as an adjunct treatment for various lung diseases (bronchial asthma, chronic bronchitis, pneumonias) but have been slowly, slowly abandoned due to the appearance of effective drug therapies on the one hand, on the other hand due to the lack of rigorous studies on their mechanisms of action and effectiveness. In recent years, however, several studies have appeared on the cellular and molecular mechanisms of physical treatment means, which opens up a new perspective on their use. COVID-19 pneumopathy is an impairment with multiple pathophysiological mechanisms and which can cause long-term sequelae by the appearance of dagger fibrosis. Physiotherapy, especially MLS laser photo biomodulation intercepts most of the pathophysiological links, relieves acute / subacute lung disease and prevents the appearance of fibrotic lesions.

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