

Radial extracorporeal shock wave therapy to support breathing in case of coronavirus disease 2019 (COVID-19): a case report

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Many patients with Coronavirus disease 2019 (COVID-19) suffer from shortness of breath and severe chest pain. Here we report successful therapy of a patient with diagnosis of COVID-19, severe chest pain and significant shortness of breath, using radial extracorporeal shock wave therapy (rESWT). The latter started seven days after beginning of symptoms and drug therapy without success, and involved daily application of 15.000 to 20.000 radial extracorporeal shock waves over the intercostal muscles as well as the paravertebral muscles of the thoracic and lumbar spine, diaphragm and flanks. Immediately after the first rESWT session the patient experienced significant pain relief and improvement of breathing. Four days later the pain had completely subsided and breathing was largely normalized. This type of noninvasive, non-pharmacologic treatment could help many COVID-19 patients or patients who still suffer from breathing problems weeks after having been infected with SARS-CoV-2, giving them back quality of life.

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ABSTRACT

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KEYWORDS

COVID-19; shortness of breath; chest pain; radial extracorporeal shock wave therapy; rESWT

INTRODUCTION

Many patients with Coronavirus disease 2019 (COVID-19) suffer from shortness of breath and severe chest pain [1]. The latter can be caused by pleurisy [2], and may substantially contribute to limitations of breathing, potentially further aggravating shortness of breath. Contemporary physical therapy measures may only have limited impact on severe chest pain relief in patients with COVID-19.

CASE REPORT

This individual case report describes a 13-year-old patient with diagnosis of COVID-19, resulting in significant shortness of breath. Individual case reports are exempt from approval of an Institutional Review Board in Germany. The first author of this case report (P.S.) has been the family doctor of the patient for many years. The patient and the patient's parents (having parental authority) gave informed consent to the treatment and the publication of this individual case report.

On January 10th, 2021 (01/10/21) the otherwise healthy patient developed severe chest pain as well as severe muscle pain in the entire thoracic area and the thoracic spine, lumbar spine and flanks on both sides, which quickly worsened. One day later (i.e., on 01/11/21) the severity of pain was 7-8 on a visual analogue scale ranging from zero (no pain) to 10 (maximum, unbearable pain). Furthermore, the patient reported increasing shortness of breath (7 on a scale ranging from 0 (breathing freely) to 10 (absolute shortness of breath / suffocation)). A PCR test for severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) was positive on 01/13/21.

Based on suspected diagnosis COVID-19 the following medication was administered to the patient starting 01/11/21: 4 mg of Dexamethasone twice a day, Fluticasone inhalation, 400 mg of Ibuprofen three times a day, 50 mg of Aspirin per day, 600 mg Vitamin C per day, 20 mg zinc per day, 7000 IE of Vitamin D3 + 200 µg Vitamin K2 per week. In addition, the patient received targeted breathing exercises and manual therapeutic treatment. However, despite the high-dose drug

therapy and the additional physical therapy, there was no improvement until 01/18/21.

Clinical examination on 01/18/21 revealed the following: patient with clearly subjective and objective dyspnoea; pain in the diaphragm area and the entire lower chest when inhaling deeply; peripheral oxygen saturation (SpO₂) = 98%; blood pressure = 100/65 mm Hg; heart rate = 96 beats per minute; minimal crackling sound on basal parts of both lungs, combined with slight wheezing and humming on expiration; significant pain on paravertebral pressure in the thoracic and lumbar spine areas, as well as pain when tapping on both sides; normal urinalysis results. Slightest physical exertion (five steps) caused immediate increase in shortness of breath and rapid exhaustion.

The patient is not known to have any allergic diathesis, asthma or any other pulmonary disease.

Normally the following therapy would have been appropriate at this time: further rest, breathing training, oral and inhalative corticosteroid, inhalation of Salbutamol, and continuation of physical therapy. A pediatric intensive care doctor friend recommended to consider inpatient monitoring.

However, because there was no success with the specific measures that had been performed so far and we no longer wanted to administer corticosteroids to the 13-year-old patient, we decided to completely discontinue medication except for Aspirin and the vitamins. Instead, we started to treat the thorax, intercostal muscles, paravertebral muscles and the diaphragm with radial extracorporeal shock wave therapy (rESWT) using a Swiss DolorClast device (Electro Medical Systems, Nyon, Switzerland). Radial extracorporeal shock waves (rESWs) are single acoustic impulses which have an initial high positive peak pressure of up to 10 megapascals (MPa) that is reached in less than one microsecond (µs), followed by a low tensile amplitude of a few µs duration that can generate cavitation, and a short life cycle of approximately 10-20 µs [3,4]. Due to these characteristics rESWs fundamentally differ from therapeutic ultrasound. During the last two decades rESWT has emerged as a noninvasive

management option for tendon and other pathologies of the musculoskeletal system, with only a few unwanted side effects such as temporary skin redness and discomfort during treatment [5,6].

Because of potential development of cavitation bubbles [3] treatment over air-filled tissue (lung, gut) is considered a contraindication by the manufacturer of the rESWT device. On the other hand, the first author of this case report (P.S.) has treated a large number of patients suffering from various diseases involving the thorax and diaphragm, including rib fractures and thoracic trauma. In our experience rESWT performed on the thorax and diaphragm can very often lead to rapid pain relief and complete regeneration of breathing, even in cases that were previously refractory to therapy. To our knowledge, treatment of chest pain and breathing problems related to COVID-19 using rESWT has not yet been published.

Radial extracorporeal shock wave therapy started on 01/19/2021 using the following protocol: one rESWT session per day; Swiss DolorClast mobile device (treatments were performed at the patient's home), Blue handpiece, 40-mm applicator, initial air pressure 1.0 bar, rESWs applied at 18 Hz, 15.000 to 20.000 rESWs per rESWT session applied over the intercostal muscles from ventral and dorsal as well as the paravertebral muscles of the thoracic and lumbar spine, diaphragm and flanks (Figure 1).

Our plan was to achieve the following therapeutic effects using rESWT: rapid pain relief [5], inhibition of inflammation [7], loosening of mucus in the lungs (mechanical effect of rESWs) and loosening of the diaphragm (also mechanical effect of rESWs) [8].

Already two hours after the first rESWT session there was significant pain relief in the treated areas, as well as about 10% easier breathing. The air pressure of the rESWT device could rapidly be increased to 1.5 bar in the following days. The patient did not cough during the treatment, indicating that pleura and lung were not irritated by the rESWs.

Four days later (i.e., on 01/23/2021) the pain had completely subsided (0/10) and breathing was largely normalized (breathing restriction 0-1/10).

A follow-up examination at a pediatric clinic on 02/21/2021 demonstrated no residuals on the lungs, except for a mild restriction of the lung capacity of 7-10% during exertion. It was decided to continue breathing exercises and performing sport at the discretion of the patient, with the aim to reach full lung capacity during the following four to six weeks.

Another follow-up examination on 02/03/2021 evidenced that the patient had remained pain-free at all areas of the body that were treated with rESWT. Breathing was completely normal at rest. When forcing higher physical exertion there was still no pain but a little restriction of breathing. However, there is progress every week and the patient hopes to be fully rehabilitated in a few weeks.



Figure 1. Treatment of a patient with COVID-19 using radial extracorporeal shock wave therapy applied over the intercostal muscles from dorsal. For illustration purposes the picture was taken without protective measures after the patient was cured and no longer positive for SARS-CoV-2.

DISCUSSION

To our knowledge this individual case report is the first one demonstrating that rESWT is able to achieve fast and effective relief of pain and pain-related breathing problems in therapy-resistant respiratory distress caused by COVID-19.

There are limitations to this case report. Specifically, only a single patient was investigated and no control treatment was performed. However, it was not the aim of this case report to establish a clinical treatment. It goes without saying that both safety and efficacy of our novel approach must be confirmed in future studies, including well-designed randomized controlled trials on a larger number of patients.

CONCLUSION

Treatment of shortness of breath in conjunction with severe chest pain using rESWT may help many patients with COVID-19 or patients who still suffer from breathing problems weeks after having been infected with SARS-CoV-2, giving them back quality of life.

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Declaration of conflicting interests

P.S. declares no potential conflicts of interest with respect to the research, authorship and/or publication of this article. C.S. received (until June 30, 2020) research funding from Electro Medical Systems (Nyon, Switzerland) for his preclinical research at LMU Munich (unrestricted grant) and consulted (until December 31, 2017) for Electro Medical Systems. However, Electro Medical Systems had no any role in study design, data collection and analysis, interpretation of the data, decision to publish and writing the manuscript. No other potential conflicts of interest relevant to this article were reported.

Ethical approval

Our institutions do not require ethical approval for reporting individual cases.

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Informed consent

Written informed consent was obtained from the patient and the patient's parents (having parental authority) for the patient's anonymized information to be published in this article.

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Availability of data and materials

All datasets used and analyzed are presented in this paper.

Authors' contributions

P.S.: treatment, data collection, initial draft of manuscript. C.S.: guide and final editing of manuscript. All authors read and approved the final manuscript.

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