Research Paper

Efficacy of Myofascial Release Therapy on the Cardiorespiratory Functions in Patients With COVID-19

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ABSTRACT

Introduction: The present study aimed to investigate the effects of Myofascial Release Therapy (MRT) on cardiorespiratory functions in patients with COVID-19.

Materials and Methods: A total of 36 patients with COVID-19 (intervention group=20, controls=16) were included in the present study. The patients in the intervention group participated in a single session of suboccipital, anterior thoracic and sternal, anterior cervical, and diaphragm myofascial release techniques, plus respiratory physiotherapy. The controls just received respiratory physiotherapy. Before-after assessments included recording heart rate, systolic and diastolic blood pressure, respiratory rate, blood oxygen saturation, chest expansion, and breathing comfort.

Results: There was a significant reduction in the heart rate and ease of breathing in the intervention group (P=0.04, P=0.02; respectively); also, the diastolic blood pressure increased significantly in the control group (P=0.02). Compared to the controls, the ease of breathing decreased significantly in the intervention group (P=0.03).

Conclusion: Myofascial release techniques of the neck, thoracic, and diaphragm, along with respiratory physiotherapy, could immediately affect heart rate and ease of breathing and prevent increasing diastolic blood pressure. If a patient with COVID-19 is stable, pulmonary physiotherapists may consider using these techniques while monitoring cardiopulmonary function.

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1. Introduction

In late 2019, a respiratory disease caused by the new human coronavirus (SARS-CoV-2) was identified in Wuhan, China. The infection is currently known as Coronavirus 2019 (COVID-19), spreading rapidly around the world. On March 11, 2020, the World Health Organization declared it a pandemic [1]. A significant percentage of the population with COVID-19 does not require hospitalization because patients develop a mild or asymptomatic disease with a good prognosis. However, the elderly and people with chronic underlying diseases may experience severe illness and develop complications such as Acute Respiratory Distress Syndrome (ARDS), sepsis, septic shock, and kidney and liver failure that require treatment in an intensive care unit with intensive support [2]. COVID-19 can also cause mild to severe pneumonia or respiratory hypoxia. In addition, the patients may be at risk for residual or developmental parenchymal damage and impaired respiratory muscle function [3]. Respiratory rehabilitation has an essential role in recovering and improving the role of the individual in society by increasing mobility, independence and restoring the quality of life of individuals [3].

Regarding the rehabilitation of hospitalized patients, respiratory assessment should include dyspnea, thoracic activity, diaphragmatic activity, respiratory muscle strength (maximum inspiratory and expiratory pressures), respiratory pattern, and frequency [4]. Airway clearance techniques include postural derange, active cycle of breathing, manual or ventilator hyperinflation, percussion and vibration, positive expiratory pressure, and mechanical inhalation and exhalation [2]. The use of airway clearance techniques can significantly reduce the need for artificial ventilation, the number of days of mechanical ventilation, and the length of hospital stay [5]. On the other hand, respiratory muscle training in patients with asthma improves maximal inhalation pressure. This increase in maximal inhalation pressure may significantly affect adaptive muscle changes, reduce respiratory motor drive, drug use, and symptoms [6]. Some evidence suggests that manual therapy in certain chronic lung diseases, such as chronic asthma and Chronic Obstructive Pulmonary Disease (COPD), can affect respiratory mechanics and increase chest wall flexibility and thoracic expansion. This technique can indirectly improve exercise capacity and lung function. There is also evidence that the respiratory muscles stretching may improve ventilation in COPD patients; the mechanism of action is through increased thoracic expansion capacity. Besides, studies have shown that manual therapy techniques that focus on the thoracic region (e.g. mobilization and manipulation) and exercise improve the range of motion, postural adaptations, and lung volumes and capacities in people with and without respiratory diseases [7]. The manual diaphragm release technique is an intervention that stretches the diaphragm muscle fibers directly, thus increasing chest mobility [8].

The COVID-19 pandemic in our society has greatly affected the economy, health care system, and politics [9]. Respiratory system involvement in the COVID-19 patients can increase the likelihood of developing acute respiratory syndrome and pneumonia and even, in severe cases, death. Thus, the need for a comprehensive and effective respiratory rehabilitation program in these patients becomes more critical.

On the other hand, in patients in the respiratory phase of the COVID-19 infection, following changes in respiratory mechanics and shallow breathing, overactivity and adaptive changes are seen in the respiratory accessory muscles and fascia of the upper thorax and neck. So the present study intended to assess the effect of the neck, thoracic and diaphragmatic muscle and fascia release on the patient's cardiac and respiratory functions. The study hypothesis was that the changes in the intervention group (myofascial release and respiratory physiotherapy) would be different from those in the control group (only respiratory physiotherapy).

2. Materials and Methods

This study was approved by the Ethics Committee of the Tehran University of Medical Sciences and the Iranian Registry of Clinical Trials. A simple non-probability sampling method was used to recruit study samples from the available patients admitted to one of the hospitals for patients with COVID-19 in Tehran City, Iran.

Study patients

A total of 36 patients with COVID-19 (intervention group=20, controls=16) were included in the present study. The inclusion criteria were as follows: definitive diagnosis of COVID-19 (PCR test positive and moderate respiratory phase), more than 6 months had passed since the onset of other acute respiratory infection, and the absence of COPD or other respiratory diseases. The exclusion criteria were as follows: body temperature over 38°C, the time of initial diagnosis or onset of symptoms was 3 days or less, the initial onset of dyspnea was 3 days or less, the chest image had worsened by more than 50% in the last 24 to 48 hours, SpO_2 90% or less, blood pressure less than 90/60 mm Hg and more than 180/90 mm Hg, breath rate was more than 40 per minutes, heart rate less than 40 and more than 120 beats per minutes, new onset of arrhythmia and myocardial ischemia, moderate to severe heart disease (grade 3 or 4, according to the New York Heart Association), with ischemic or hemorrhagic stroke or neurodegenerative diseases, decreased level of consciousness [5], reluctance to continue treatment, and finally discharge with personal consent.

Study procedure

Before taking the test, the patients are informed about the study protocol. An experienced physiotherapist explained the duration of each session (approximately 40 minutes for the intervention group and 20 minutes for the control group), the type of evaluation, intervention, and absence of any harmful effects to the study patients. Then, the patients signed the informed consent form. Afterward, they were presented with a personal and demographic information questionnaire, including age, height, weight, smoking history, and underlying diseases. The assessment and intervention time for each patient was one hour after breakfast and before lunch. The patients with COVID-19 were randomly assigned to the intervention and control groups. The assessments were performed before and immediately after the intervention.

Assessments

Assessments included the recording of heart rate, systolic and diastolic blood pressure, respiratory rate, blood oxygen saturation (SpO_2), chest expansion, and ease of breathing. All patients were under cardiopulmonary monitoring, so their heart rate, systolic and diastolic blood pressure, respiratory rate, blood oxygen saturation (SpO_2) were recorded.

Chest expansion

To measure the chest expansion, we asked the patients to stand and place their hands on their heads. Then they were asked to take a deep breath. Chest expansion was measured at 2 levels: upper chest expansion at the level of the third intercostal space and lower chest expansion at the xiphoid process level with a tape measure [8]. The anatomical landmarks used to measure upper chest expansion was the spinous process of the fifth thoracic vertebra, the midline of the clavicular line, and the third intercostal space. Anatomical landmarks to measure lower chest expansion were the spinous process of the 10th thoracic vertebra and the xiphoid process. Measurements were made at the end of the inspiration and expiration cycles. The therapist placed the zero point (start) of the tape measure on the spinous process. The tape did not put extra pressure on the chest wall. To measure the amount of chest expansion, we subtracted the amount of expiration from the inspiration.

Ease of breathing

The breathing comfort is assessed by Visual Analog Scale (VAS) that ranges from 0 to 10. Zero refers to breathing easily and deeply, without restriction. Ten refers to breathing limitation and a shortage of breath. This subjective scale should be taught to the patient, who were asked to mark their feelings about breathing on the VAS ruler [10].

Study intervention

After the initial assessments, the patients were randomly assigned to the intervention (myofascial release therapy plus respiratory physiotherapy) and control (only respiratory physiotherapy) groups.

Respiratory physiotherapy

In the control group, routine respiratory physiotherapy was performed, which included training of breathing exercises (deep inhalation and exhalation), cough training, diaphragmatic training; each person performed 30 diaphragmatic breaths in the supine position and using external vibration to drain mucus. Since posture plays a vital role in respiratory function, patients were encouraged to be as upright as possible in the head and neck during these procedures and avoid slumped positions [11].

The patient was asked to sit on the edge of the bed, with the lower limbs hanging from the bed. The treated lobes were the anterior, middle, and lower lobes of the right lung, the upper and lower lobes of the left lung from the anterior surface, and the upper and lower lobes of both lungs from the posterior surface.

Breathing exercises

To do breathing exercises, we asked the patients to put their hands behind their necks and bring the elbows together in front of their bodies and bend forward. Then the patients were asked to breathe through their noses as extending their elbows apart and straightened their torso. As the patients returned to their original positions, they exhaled slowly through their mouths. This exercise was repeated ten times. In the next breathing exercise, the patients raised their hands above their heads and took a deep breath through their noses, then exhaled slowly through their mouths as they were bending toward their ankles and crossed the arms to the ankles. This exercise was repeated ten times.

Cough training

Training and performing cough were done in a sitting position on the edge of the bed, and the patient bent forward slightly. The patients were asked to take a deep breath slowly with their hands on the abdomen (diaphragmatic breathing). Then, while exhaling, they pressed the abdomen with their hands, coughing 2 to 3 times with their mouths half-open. The mucus came out like this, and the patients collected it with the fascial tissues. This exercise was repeated 5 times. After this exercise, the fascial tissues were placed in a plastic bag and thrown out.

External vibration

We used the Vibrator Massager (Thrive, 717 made in Japan), and the application time was 10 minutes on the above-mentioned lobes.

Myofascial release therapy

In the intervention group, in addition to the respiratory physiotherapy, the following 4 fascial release techniques were performed, each lasting approximately 5 minutes.

Suboccipital release

The physiotherapist raised his fingertips toward the ceiling and placed his hand just below the occiput, creating pressure to release the tissues in this area. The therapist then applied gentle traction between the occiput and the atlas (Figure 1) [12].

Figure 1. Suboccipital release technique

Anterior thoracic myofascial release and sternal release

The physiotherapist placed one hand under the patient's head, just below the occiput, and held it between his thumb and forefinger, creating support in this area. The therapist's other hand rests on the sternum, with the middle finger on the midline of the sternum and the heel of the hand just below the sternal joint. Distraction moves the fascia and sternochondral joints away from each other, and the pressure was maintained until the tissue was released (Figure 2) [12].

Anterior cervical myofascial release

The physiotherapist placed one hand on the lower angle of the jaw and the other hand just below the lower edge of the clavicle. The therapist exerted a downward force on the lower edge of the clavicle and an upward force on the jaw for both sides. This pressure was maintained until the tissue was released (Figure 3) [12].

Diaphragm release

The patients were asked to lie on their backs and relax their limbs. The physiotherapist stood beside the patient's bed, placing one hand on the diaphragm level exerting gentle pressure, while the other hand was placed under the patients' trunks, parallel to the upper hand. The pressure was maintained until the tissue was released (Figure 4) [13].

End of the treatment

Whenever symptoms worsened, such as dyspnea occurred, SpO_2 fell below 85%, and the heart rate exceeded the predicted maximum heart rate (120 beats per minute), the intervention would be stopped [14].

Figure 2. Anterior thoracic myofascial release and sternal release technique

Figure 3. Anterior cervical myofascial release technique

Figure 4. Diaphragm release technique

Personal protection in the study

Personal protective equipment, including gloves, masks, face shields, and insulated clothing, were used to assess and treat the patient to reduce the infection's risk. Immediately after contact with the patient and contaminated objects, regular hand hygiene and washing was observed. Evaluation and intervention were done with caution and monitoring and in a closed room with open windows. The patients were asked to cover their mouth and nose when sneezing or coughing and to throw away their fascial tissues immediately.

Statistical analysis

The SPSS version 17 was used for data analysis. The Kolmogorov-Smirnov test was used to check the normal distribution of continuous variables. The paired t-test was used to compare before-after intervention values of heart rate, systolic blood pressure, diastolic blood pressure, respiratory rate, SpO_2, chest expansion, and ease of breathing in each group. The independent t-test was used to compare the mean difference of before-after values between two groups. Statistical significance was set at less than 0.05.

3. Results

Data regarding the baseline characteristics of the participants are presented in Table 1. The Kolmogorov-Smirnov test showed the normal distribution of the study variables (P>0.05). Table 2 presents the paired t-test results for assessing the changes of each variable during this study procedure and the independent t-test for comparing the two groups (intervention-control).

Heart rate and ease of breathing decreased in the intervention group (P=0.04, P=0.02; respectively), but there were no significant changes in the other variables in this group. There were no significant changes in the control group except for the diastolic blood pressure (P=0.02).

The change of the diastolic blood pressure was greater in the control group (mean difference=-4.29, P=0.03), and ease of breathing had significantly reduced compared to the controls (mean difference=-1.01, P=0.03).

Table 1. Baseline characteristics of the participants (intervention group=20, control group=16)

Variables	Mean±SD		Mean Difference	%95 Confidence Interval	P (Effect Size)
	Intervention Group	Control Group			
Age (y)	53.15±14.08	43.94±14.32	-9.21	-18.89 0.46	0.06(0.16)
Weight (kg)	80.40±15.62	78.12±10.81	-2.27	-11.62 - 7.07	0.62(0.04)
Height (cm)	172.35±9.15	169.94±8.20	-2.41	-8.37 - 3.55	0.42(0.07)
BMI (kg/m^2)	26.99±4.30	26.97±2.42	-0.01	-2.46 - 2.43	0.99(0.01)

Table 2. Intra-group and intergroup comparison of the study variables (intervention group=20, Control group=16)

Variables	Groups	Mean±SD		P (Effect Size)	Mean Difference	P (Effect size)
		After	Before			
Heart rate (bpm)	Intervention	73.00±13.66	77.65±15.17	0.04*(0.08)	-1.77	0.61(0.04)
	Control	74.25±12.40	77.12±14.46	0.32(0.05)		
Systolic blood pressure (mm Hg)	Intervention	127.20±15.03	126.90±13.84	0.91(0.01)	-2.26	0.51(0.06)
	Control	126.06±14.25	123.50±12.98	0.25(0.05)		
Diastolic blood pressure (mm Hg)	Intervention	79.20±12.44	77.90±13.13	0.34(0.02)	-4.39	0.03*(0.18)
	Control	81.06±8.53	75.37±8.77	0.02*(0.16)		
Respiratory rate (bpm)	Intervention	19.90±4.20	19.40±5.02	0.64(0.03)	0	1(0)
	Control	19.02±6.60	18.62±4.51	0.69(0.02)		
SpO_2(%)	Intervention	94.45±2.30	95.05±2.04	0.10(0.07)	-0.91	0.21(0.03)
	Control	94.44±3.14	94.12±2.00	0.65(0.03)		
Chest expansion (Rib) (cm)	Intervention	3.47±1.58	3.63±1.28	0.46(0.03)	-0.18	0.55(0.04)
	Control	3.66±1.71	3.63±1.26	0.91(0.01)		
Chest expansion (Xiphoid) (cm)	Intervention	3.95±1.96	4.07±1.96	0.45(0.06)	0.21	0.58(0.18)
	Control	3.92±1.17	4.14±1.72	0.50(0.04)		
Ease of breathing	Intervention	0.89±0.98	1.71±1.85	0.02*(0.14)	-1.01	0.03*(0.53)
	Control	2.31±2.34	2.21±2.04	0.83(0.01)		

*Indicates significant result (P<0.05).

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4. Discussion

The present study examined the effect of a single session of myofascial release therapy on cardiorespiratory functions in patients with COVID-19. The main findings of the present study were that myofascial release therapy plus respiratory physiotherapy compared to respiratory physiotherapy alone improved ease of breathing and decreased heart rate. Moreover, in the control group, the diastolic blood pressure increased significantly. Systolic blood pressure, respiratory rate, SpO_2, chest expansion at the third rib, and xiphoid process levels did not show any significant changes in both groups.

Because COVID-19 is a new disease and little is known about it, few studies have been done on the respiratory physiotherapy of these patients, one of which is mentioned at the end. Also, according to the authors' research, no study has been done to examine the effects of manual therapies on the respiratory function of these patients, so we had to use studies that examined the effectiveness of manual treatments on the pulmonary function of a healthy population or COPD patients.

Rocha et al. evaluated the effects of a single session of manual therapy on the thoracic spine and thorax on dynamic pulmonary function in healthy adults. Lung function was assessed at baseline, 1 minute, 20 minutes, and 30 minutes after the intervention. This study did not support the use of manual therapy for short-term efficacy in respiratory function in healthy adults [15]. Although in this study, more mobilization techniques were used and less attention was paid to soft tissue and also was done on healthy participants, i.e., those who had normal biomechanics of respiration, similar to our study, no significant improvement in pulmonary parameters was observed.

A systematic review showed a lack of evidence for the use of manual therapy as a companion management method in COPD. The results show that further studies are required to understand the nature and extent of these changes in the musculoskeletal system in COPD patients and their possible associations with pulmonary function [16]. Yelmaz Yelvar et al. investigated the immediate effects of manual therapy on respiratory function and respiratory muscle strength in patients with COPD. The results showed that a single manual therapy session could immediately improve lung function, respiratory muscle strength, and oxygen saturation and reduce dyspnea, fatigue, heart rate, and respiration in patients with severe COPD. Manual therapy protocol included suboccipital decompression techniques, anterior-posterior cervical joint glide, myofascial release of sternocleidomastoid and trapezius muscles, myofascial release of intercostal and paravertebral muscles and diaphragm, scapulothoracic mobilization, and anterior-posterior mobilization of the thoracic spine [10]. Cruz-Montecinos et al. investigated the effects of Soft Tissue Manual Therapy Protocol (STMTP) on the accessory respiratory muscles and their associated structures in patients with severe COPD. Residual volume, respiratory capacity, and oxygen saturation (SpO_2) were recorded immediately before and after STMTP application. The results showed that the residual volume, respiratory capacity, and SpO_2 increased. A single session of STMTP can rapidly induce significant clinical improvements in pulmonary function in patients with severe and extremely severe COPD [12]. Nair et al. showed that both the diaphragm stretching and manual diaphragm release technique could be prescribed to improve safe diaphragm expansion for COPD patients who are clinically stable [8].

In summary, the studies that have examined the effect of manual therapies in patients with COPD used a combination of mobilization, manipulation, myofascial release, MET, and stretching. Therefore, the results belonged to one specific intervention. In our study, among all of the parameters related to respiratory function, only ease of breathing improved, and other parameters such as respiratory rate, SpO_2, and chest expansion did not change significantly. One reason might be related to no adaptive changes in the muscular tissue and fascia of these patients at the onset of COVID-19 disease. Therefore, myofascial techniques may not be effective, given the chronic nature of COPD in which changes have occurred in the respiratory accessory muscles and somehow need treatment.

Liu et al. examined the effects of a 6-week respiratory rehabilitation on respiratory function, quality of life, mobility, and psychological function in elderly patients with COVID-19. The results showed that 6 weeks of pulmonary rehabilitation could improve respiratory function, quality of life, and anxiety in elderly patients with COVID-19 but slightly improved their depression [14]. In our study, the only significant change in the respiratory rehabilitation group (control) was increased diastolic blood pressure, and other cardiorespiratory parameters did not change significantly. We hypothesize that coughing exercises increased diastolic blood pressure in these patients, but in the intervention group, myofascial release techniques prevented such increase and decreased heart rate; there is evidence that myofascial release can have an immediate effect on internal organs and the cardiovascular system [17]. Also, there have been previous studies on respiratory physiotherapy in children with pneumonia, which are also consistent with our research in terms of the effectiveness of respiratory physiotherapy in reducing heart rate [18, 19].

5. Conclusion

After using myofascial release techniques, significant effects on heart rate and respiratory rate were observed in patients with COVID-19. It is also possible that this manual therapy can prevent the increase in diastolic blood pressure following coughing exercises. Therefore, it is suggested that researchers in future studies pay more attention to applying these techniques and other similar ones plus long-term effects in managing patients with COVID-19. The limitations of this study included the low sample size as due to the patients' condition, a small number of hospitalized patients met the inclusion criteria. Also, the treatment was a single session, and its immediate effects were investigated.This study suggests that myofascial release be added to the respiratory rehabilitation programs because it could immediately affect the heart rate and ease of breathing.

Ethical Considerations

Compliance with ethical guidelines

All study procedures were performed in accordance with the ethical standards. This project was approved by the Ethics Committee of the Tehran University of Medical Sciences (Code: IRCT20210214050356N1).

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Authors' contributions

Conceptualization and supervision: Azadeh Shadmehr and Sara Fereydounnia; Methodology: Sara Fereydounnia, Azadeh Shadmehr; Investigation, writing – original draft, and writing – review & editing: All authors; Data collection: Alireza Tahmasbi; Data analysis:Sara Fereydounnia; Funding acquisition and Resources:Azadeh Shadmhr.

Conflict of interest

The authors declared no conflict of interest.

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