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A Follow-Up Study of Pulmonary Function and Health Characteristics in Post Covid Survivors

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Abstract

Background: The data about COVID-19 impact on lung function and physical impairment at follow up also varied. The aim of this study to evaluate the fatigue level, sleeping status and pulmonary function of POST COVID survivors. **Materials & Methods:** This single-center prospective experimental study was performed to determine the fatigue level, sleeping status and pulmonary function of Post-COVID survivors. The study was conducted in the department of physiology at NCRIMS, Meerut, Uttar Pradesh, India from Dec. 2020 to June 2021. The experimental group was divided into two parts: COVID patients with pneumonitis, and COVID patients without pneumonitis. Control group were consisted of 15 Non-COVID subjects. Each of the part of experimental group were consist of 15 COVID patients as well as control group were also consisted of 15 Non- COVID subjects. A total number of 45 subjects included in the study. The pulmonary function tests were performed using Vmax Encore (Viasys® Healthcare, USA). The following parameters were measured: forced vital capacity (FVC), forced expiratory capacity at the first second of exhalation (FEV1), FVC/FEV1 ratio, total lung capacity (TLC), vital capacity (VC), residual volume (RV) measured by means of the single-breath test. The test was completed by each patient, and the results were compared between the disease severity groups. One-way ANOVA was used to evaluate the mean differences when comparing more than 2 groups. A two-tailed p-value less than 0.05 was considered to be significant. Statistical analysis was performed using Statistical Analysis System (SAS) package version 21.0. **Results:** The mean age of the patients was 51.3 (SD-11.8) years in control groups, 54.2 (SD-10.9) years in Covid with pneumonitis group and 52.6 (SD-11.7) years in Covid without pneumonitis group. The comparison between groups was statistical nonsignificant (P>0.05). Females were slightly preponderance in our study. Only one patient showed obstructive impairment, reduced lung volume was found in 1/30 of patients in experimental groups: TLC reduction was observed in 5/30 (16.6%) patients (range 53–104%), and VC reduction in 2/30 patients (6.6%; range 60–161%). Eight patients (26.66%) had reduced physical capacity in the 6 MWT. The median value was 101.5% of the optimal value (range 70–131%). The SF-36 scores demonstrated a reduction in the reported health status across all domains in comparison with an age-matched population. **Conclusion:** We conclude that breathing exercise was most useful for pulmonary function and health characteristics in post covid survivors. According to this data, a period of 6 months is not enough for patients' complete recovery, and a longer follow-up is needed to determine the consequences of this disease.

Keywords: Post Covid Survivors, Pneumonitis, COVID-19, Pulmonary Function Test.

Introduction

Coronavirus Disease 2019 (COVID-19) is caused by a novel coronavirus, a new and highly contagious respiratory disease caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), which presented a risk of infection from human to human[1]. The current outbreak of COVID-19 has caused a global pandemic. Person-to-person transmission of SARS-CoV-2 has gained global attention and extensive measures to effectively control the outbreak and treatment of COVID-19. The knowledge about COVID-19, including clinical manifestations, pathogenesis, even treatment came from research and observation during the acute infection period[2,3].

The entry route of SARS-CoV-2 in to the human cells is mainly facilitated by the angiotensin-converting enzyme 2 (ACE2) receptors, which seem to be expressed by type 2 pneumocytes[4]. The binding of SARS-CoV-2 to the ACE2 receptors could arise into acute systemic inflammatory responses and cytokine storm, consequentially leading to lung-resident dentritic cells (rDCs) activation, and to T lymphocytes production and release antiviral cytokines into the alveolar septa and interstitial compartments[5].

However, the knowledge about the sequelae of SARS-CoV-2 infection remains limited.

Recent evidence suggests that the lungs are the organ most affected by COVID-19[6] with different pathophysiological events that include diffuse alveolar epithelium destruction, hyaline membrane formation, capillary damage and bleeding, alveolar septal fibrous proliferation, and pulmonary consolidation[7]. A characteristic of COVID-19 is the extensive injury to alveolar epithelial cells and endothelial cells with secondary fibroproliferation[8], indicating a potential for chronic vascular and alveolar remodeling leading to lung fibrosis and/or pulmonary hypertension[9]. These findings generate concerns regarding the assessment of lung injury for discharged patients[7].

Different types of functional respiratory evaluations can be carried out objectively, the most commonly used are pulmonary function tests (PFTs), such as spirometry, diffusion capacity and lung volumes[10], However, other tests that complement lung function tests, such as the evaluation of respiratory muscles or airway resistance, can help to improve the study of the properties of the lung and allow us to determine the consequences of acute or chronic respiratory disease objectively. The aim of this study to evaluate the fatigue level, sleeping status and pulmonary function of Post COVID survivors.

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Materials & methods

This single-center prospective experimental study was performed to determine the fatigue level, sleeping status and pulmonary function of Post-COVID survivors. The study was conducted in the department of physiology at NCRIMS, Meerut, Uttar Pradesh, India from dec. 2020 to June 2021. Ethical approval was obtained from the Institutional Ethical Committee (IEC21/NCRIMS 13/physio-002-op/21/12/2020).

Participants

An experimental cohort study was conducted on the post COVID survivors. The experimental group was divided into two parts: COVID patients with pneumonitis, and COVID patients without pneumonitis. Control group were consisted of 15 Non-COVID subjects. Each of the part of experimental group were consist of 15 COVID patients as well as control group were also consisted of 15 Non- COVID subjects. A total number of 45 subjects included in the study.

Data Collection

From the hospital database, the medical records of the participants were reviewed, and the demographic data, comorbidities, clinical and laboratory tests results, and chest radiological data at the time of hospitalization (acute disease) were analyzed. At the control visit 3 months after the discharge from the hospital, chest a CT scan, lung function tests, and the 6-Minute Walk Test (6 MWT) were performed; patients completed 36-SF questionnaire.

Pulmonary Function Testing and 6 MWT

The pulmonary function tests were performed using Vmax Encore (Viasys® Healthcare, USA). The following parameters were measured: forced vital capacity (FVC), forced expiratory capacity at the first second of exhalation (FEV1), FVC/FEV1 ratio, total lung capacity (TLC), vital capacity (VC), residual volume (RV) measured by means of the single-breath test. Pulmonary function tests were analyzed based on the ATS-ERS guidelines[11]. All parameters were expressed as percentages of the predicted normal value; the lower limits of normal (LLN) were taken into account. The 6-minute Walk Test (6 MWT) was performed according to ATS/ERS guidelines, with baseline SpO2 measured by pulse oximetry[12,13].

SF-36 Questionnaire

The SF-36 questionnaire consists of 36 question that evaluate 8 health domains: physical functioning (PF), social functioning (SF), role limitation due to physical problems (RP), role limitation due to emotional problems (RE), mental health (MH), bodily pain (BP), vitality (VT), and general health (GH). Scores for each aspect range from 0 (worst) to 100 (best), with higher scores indicating better health-related quality of life (HRQoL). Standard test-scoring algorithms and related interpretation were used[14]. The test was completed by each patient, and the results were compared between the disease severity groups[15].

Statistical Analysis

Descriptive statistics such as frequency tables and mean (standard deviation) were used to describe quantitative and qualitative data, respectively. Differences between two independent quantitative and qualitative groups were evaluated by the Student's t-test and Fisher exact test, respectively. One-way ANOVA was used to evaluate the mean differences when comparing more than 2 groups. A two-tailed p-value less than 0.05 was considered to be significant. Statistical analysis was performed using Statistical Analysis System (SAS) package version 21.0.

Results

The mean age of the patients was 51.3 (SD-11.8) years in control groups, 54.2 (SD-10.9) years in Covid with pneumonitis group and 52.6 (SD-11.7) years in Covid without pneumonitis group. The comparison between groups was statistical nonsignificant (P>0.05). Females were slightly preponderance in our study.

More than half of the patients (53.33%) were obese (mean body mass index (BMI) of 31.17 (SD-5.95)) in experimental group and half of the patients had comorbidities (table 1).

Table 1: Demographics and clinical characteristics of the patients

Variables	Control group	Covid with pneumonitis	Covid without pneumonitis	P-value
Age (yrs) (Mean±SD)	51.3±11.8	54.2±10.9	52.6±11.7	>0.05
Gender				
Male	8	6	7	>0.05
Female	7	9	8	
Medical history				
Hypertension	2	9	6	>0.05
Diabetes mellites	3	7	2	
Other diseases	2	3	2	
BMI (Kg/m²)				
Normal BMI	10	3	3	<0.05*
Overweight	3	6	2	
Obese	2	6	10	

Only one patient showed obstructive impairment, reduced lung volume was found in 1/30 of patients in experimental groups: TLC reduction was observed in 5/30 (16.6%) patients (range 53–104%), and VC reduction in 2/30 patients (6.6%; range 60–161%). Eight patients (26.66%) had reduced physical capacity in the 6 MWT. The median value was 101.5% of the optimal value (range 70–131%) (table 2).

Table 2: Pulmonary function and physical capacity at follow-up

Pulmonary function test	Value	Covid with pneumonitis	Covid without pneumonitis
FVC	Normal	14	15
	Below normal	1	0
FEV1	Normal	14	15
	Below normal	1	0
FEV1/FVC	Normal	14	15
	Below normal	1	0
TLC	Normal	12	13
	Below normal	3	2
VC	Normal	15	13
	Below normal	0	2
6 MWD (mt.)		530.8±46.27	550.3±98.20

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The SF-36 scores demonstrated a reduction in the reported health status across all domains in comparison with an age-matched population. The lowest scores were observed for limitations of social activities due to physical problems, vitality, and general health (table 3). No statistically significant difference between groups with different experimental group was found.

Table 3: HRQoL results for groups with pneumonitis & without pneumonitis and the general (healthy) population

HRQoL	Control group	Covid with pneumonitis	Covid without pneumonitis
Physical functioning	83.5±5.2	68.2±6.3	72.3±5.7
Social functioning	82.7±6.5	70.1±5.8	74.5±6.3
Role limitation physical	80.6±5.7	48.8±6.6	52.2±5.6
Role limitation emotional	81.52±3.9	60.5±4.8	70.24±4.7
Mental health	76.65±4.7	68.42±5.3	72.78±6.2
Vitality	68.23±4.3	56.39±3.8	60.52±4.9
Pain	80.3±2.9	68.5±3.2	70.2±3.4
General health	72.5±4.3	52.8±5.1	55.3±.9

Discussion

Our analysis of the association between demographic characteristics and severity of COVID-19 complements most of the literature data. Male gender, obesity, and presence of comorbidities are highly associated with the severity of COVID-19 and a prolonged recovery period[16,17].

The data about COVID-19 impact on lung function and physical impairment at follow up also varied. We found only one study (by A. Daher et al[18].) showing no impairment in lung function 6 weeks after hospital discharge and no desaturation in the 6 MWT, though with a decreased 6 MWD. Obstructive lung function abnormality is not characteristic of COVID-19, SARS, or MERS in the literature[18-21]. Our study data are in line with these results.

Our study results are similar to the data of Zhaoa et al[19]. and the data of SARS survivors 6 months after the disease[22].

The HRQoL (SF-36) questionnaire scores in our study were reduced across all domains, with the lowest regarding limitations in social activities because of physical problems, vitality, and general health. Sar-van der Brugge et al[23]. showed similar results, with the exception of body pain. In this recent study, analysis of SF-36 scores and DLCO reduction showed a weak correlation that the authors interpreted as evidence of the fact that quality of life is determined by more aspects than physical functioning only. Our results complement other publications data[24,25], showing lowered HRQoL scores at follow-up in multiple domains in COVID-19 survivors. Comparing SARS survivors, reduced HRQoL in multiple domains were observed even at 12 or 24 months[26,27]. Therefore, further follow-up is needed to evaluate this parameter.

Conclusion

Patients with COVID-19 require long-term follow-up even after recovery for observation and management of their post-COVID ailments. We conclude that breathing exercise was most useful for pulmonary function and health characteristics in post covid survivors. According to this data, a period of 6 months is not enough for patients' complete recovery, and a longer follow-up is needed to determine the consequences of this disease.

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