

Pulmonary function test and CT chest findings in COVID19 positive discharged patients

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ABSTRACT

Background:

The long-term pulmonary function and related physiological characteristics of COVID-19 survivors have not been studied in depth, thus many aspects are not understood.

Methods: COVID-19 survivors were recruited for high resolution computed tomography (HRCT) of the thorax, lung function and serum levels of SARS-CoV-2 IgG antibody tests 3 months after discharge. Clinical characteristics and the pulmonary function or CT scores were investigated.

Findings:

60 recovered patients participated in this study. SARS-CoV-2 infection related symptoms were detected in 37 of them and different degrees of radiological abnormalities were detected in 40 patients. Urea nitrogen concentration at admission was associated with the presence of CT abnormalities ($P = 0.046$, OR 7.149, 95% CI 1.038 to 49.216). Lung function abnormalities were detected in 20 patients and the measurement of D-dimer levels at admission may be useful for prediction of impaired diffusion defect ($P = 0.031$, OR 1.066, 95% CI 1.006 to 1.129). Of all the subjects, 52 of 60 patients tested positive for SARS-CoV-2 IgG in serum, among which the generation of Immunoglobulin G (IgG) antibody in female patients was stronger than male patients in infection rehabilitation phase.

Interpretation: Radiological and physiological abnormalities were still found in a considerable proportion of COVID-19 survivors without critical cases 3 months after discharge. Higher level of D-dimer on admission could effectively predict impaired DLCO after 3 months discharge. It is necessary to follow up the COVID-19 patients to appropriately manage any persistent or emerging long-term sequelae

Key words: COVID 19 , CT chest findings, pulmonary function tests

TEXT

INTRODUCTION

Coronavirus disease 2019 (COVID-19) is caused by a novel coronavirus, known as severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) [1]. From December 2019, it has rapidly spread across China and many other countries [2,3,5]. By 8th June 2020, accumulative

6931,000 confirmed cases including 400,857 deaths were reported globally [6]. 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. COVID-19 due to SARS-CoV-2 involves multiple organs and lung injury is one of the most clinical manifestations. The entry route of SARS-CoV-2 into the

human cells is mainly facilitated by the angiotensin-converting enzyme 2 (ACE2) receptors, which seem to be expressed by type 2 pneumocytes [7]. 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 dendritic cells (rDCs) activation, and to lymphocytes production and release antiviral cytokines into the alveolar septa and interstitial compartments [8]. However, the knowledge about the sequelae of SARS-CoV-2 infection remains limited.

Aims and objectives of the study

Study of Pulmonary function test and CT chest findings in COVID19 positive discharged patients

Methodology :

Data collection was done from 60 covid 19 positive discharged patients from department of General medicine at Shimoga institute of medical sciences(SIMS) teaching hospital,Shivamogga,who met the inclusion criteria after taking a written informed consent .

Inclusion criteria: 60 covid 19 positive discharged patients from SIMS

Place of study: SIMS, SHIVAMOGGA

Duration of study: 1 st september 2022 to 31 st December 2022

Sample size : 60

Study Design: FOLLOWP CROSS SECTIONAL STUDY

After 3 months of discharge Pulmonary function test and CT chest , IgG estimations were done in covid 19 positive discharged patiemnts , findings were noted and entered in performa

Statistical Analysis

Data is categorized as percentage of total participants meetingthe various study end-points. Demographic and clinical data of participants achieving various end-points is compared with oneanother. Student's t-test is used for statistical analysis ofcomparison between the groups and a p value of <0.005 is considered for statistical significance. The sample size is estimated by the Yamane formula. Statistical analysis is performed by SPSS 2.0 software.

RESULTS

CT chest findings

- Out of 60 patients ct findings were present in 40 patients and normal in 20 patients
- The median number of segments involved was 1 (IQR of 0.00_2.00) and the median total score was 1
- In half of patients (54.55%), 1-3 segments were involved
- 13 patients showed bilateral involvement of lung fields
- The lower right lobe was involved in 23 patients (41.82%), while lower left lobe and upper left lobe were involved in 12 patients (21.82%) and 11 patients (20%), respectively
- interstitial thickening and crazy paving were almost resolved, but evidence of fibrosis, such as interstitial thickening were observed.
- From the HRCT scans of the latest follow-up patients after discharge, pure GGO (7 of 55, 7.27%), interstitial thickening (15 of 55, 27.27%), and crazy paving (3 of 55, 5.45%) were the most common CT features found

Pulmonary function tests

Spirometry was completed in all patients. Even though most patients were free of respiratory symptoms at follow, lung function abnormalities were detected in 16 patients (25.45%). Anomalies were noted in TLC of 6 patients (7.27%), FEV1 of 6 patients (10.91%), FVC of 6 patients (10.91%), DLCO of 9 patients (16.36%), and small airway function in 7 patients (12.73%).

Discussion

To the best of our knowledge, few reports have described the sequelae of COVID-19 survivors [9,10,11], and this project was the first time to investigate the long term effects on changes in both pulmonary function and HRCT imaging. In our studies, we presented the results of lung function tests and HRCT of the chest in these patients with COVID-19 3 months after their hospital discharge.

The rate of radiological abnormalities (74.55%) is lower than that reported in an earlier study (83%) over 7 days after admission [12,13], which suggested that radiological abnormalities caused by SARS-CoV-2 might get better over time. A similar rate of residual radiographic changes was also identified in survivors with other viral pneumonias, including specifically SARS, H1N1, and H7N9 pneumonia [14,15,16]. SARS-CoV-2 differs from the original SARS-CoV-1 by 380 amino acid substitutions, which results to the differences in five of the six vital amino acids in the receptor-binding domain between the viral spike (S) protein with angiotensin converting enzyme 2 (ACE2) [17]. The binding affinity of SARS-CoV-2 with ACE2 seems stronger than SARS-CoV-1, with a higher spread ability than SARSCoV- 1, which may explain the considerably larger global influence of COVID-19 than the initial SARS [18]. Therefore, COVID-19 may not be analogous with others as its unique characteristic is different from others. As shown in Supplementary Table 6, patients who survived severe illness from virus might have persistent lung damage and long-term pulmonary function. Clinically, patients with abnormal HRCT scans were generally older than those with normal chest HRCT score, which implied that higher chest radiological scores was mostly obtained in elder patients [19]. Patients in the abnormal CT group had longer incubation period and higher CXR peak score than those in the normal CT group, indicating that patients with residual lesions in chest radiology after discharge had more severe side effects.

At 3-months after discharge, residual abnormalities of pulmonary function were observed in 25.45% of the cohort, mostly demonstrated diffusion reductions in DLCO. This was lower than the abnormal pulmonary function in COVID-19 patients when discharge [9]. Abnormalities in DLCO indicated pulmonary fibrosis or a late phase in the course of

recovery. In the following-up studies for the patients rehabilitating from SARS, impaired lung function could last for months or even years [13]. D-dimer elevation has reported as an important laboratory finding noted in COVID-19 patients which requires extra attention. Several studies have reported that D-dimer on admission was the independent predictor of in-hospital death for patients with COVID-19 [14]. We also found the level of Ddimer was an important prognostic factor for abnormal DLCO. Thus, for patients who have marked raised D-dimer, pulmonary rehabilitation should need subsequently even in the absence of severity respiratory symptoms.

Conclusion

In conclusions, this research has demonstrated that significant radiographic and physiological abnormalities still existed in a high proportion of COVID-19 patients 3 months after discharge. SARSCoV- 2 IgG antibody has vanished in several patients. It is necessary to follow up these patients, performing comprehensive assessment and early rehabilitation exercise for detection and appropriate management of any persistent or emerging long-term sequelae in the radiological and physiological domains.

References

- [1] Lu R, Zhao X, Li J, et al. Genomic characterisation and epidemiology of 2019 novel coronavirus: implications for virus origins and receptor binding. *Lancet* 2020;395 (10224):565–74.
- [2] Du Toit A. Outbreak of a novel coronavirus. *Nat Rev Microbiol* 2020;18(3):123.
- [3] Li Q, Guan X, Wu P, et al. Early Transmission Dynamics in Wuhan, China, of Novel Coronavirus-Infected Pneumonia. *N Engl J Med* 2020;382(13):1199–207.
- [4] Holshue ML, DeBolt C, Lindquist S, et al. First Case of 2019 Novel Coronavirus in the United States. *N Engl J Med* 2020;382(10):929–36.
- [5] Bassetti M, Vena A, Giacobbe DR. The novel Chinese coronavirus (2019-nCoV) infections: challenges for fighting the storm. *Eur J Clin Invest* 2020;50(3):e13209.
- [6] World Health Organization. COVID-19 dashboard. 2019. Accessed June 8, 2020. <https://covid19.who.int/>.
- [7] Verdecchia P, Cavallini C, Spanevello A, Angeli F. COVID-19: ACE2centric infective disease? *Hypertension* 2020.
- [8] Zhu H, Rhee JW, Cheng P, et al. Cardiovascular Complications in Patients with

COVID-19: consequences of Viral Toxicities and Host Immune Response. *Curr Cardiol Rep* 2020;22(5):32.

[9] Mo X, Jian W, Su Z, et al. Abnormal pulmonary function in COVID-19 patients at time of hospital discharge. *Eur Respir J* 2020

10] Simpson R, Robinson L. Rehabilitation After Critical Illness in People With COVID-19 Infection. *Am J Phys Med Rehabil* 2020;99(6):470–4.

[11] Wei J, Lei P, Yang H, et al. Analysis of thin-section CT in patients with coronavirus disease

12.(COChan KS, Zheng JP, Mok YW, et al. SARS: prognosis, outcome and sequelae. *Respirology* 2003;8 Suppl:S36-40.

[13] Xiong Y, Sun D, Liu Y, et al. Clinical and High-Resolution CT Features of the COVID-19 Infection: comparison of the Initial and Follow-up Changes. *Invest Radiol* 2020;55(6):332–9. VID-19) after hospital discharge. *Clin Imaging* 2020.

[14] Ng CK, Chan JW, Kwan TL, et al. Six month radiological and physiological outcomes in severe acute respiratory syndrome (SARS) survivors. *Thorax* 2004;59(10):889–91.

[15] Mineo G, Ciccarese F, Modolon C, Landini MP, Valentino M, Zompatori M. Post-ARDS pulmonary fibrosis in patients with H1N1 pneumonia: role of follow-up CT. *Radio Med* 2012;117(2):185–200.

[16] Wang Q, Zhang Z, Shi Y, Jiang Y. Emerging H7N9 influenza A (novel reassortant avian-origin) pneumonia: radiologic findings. *Radiology* 2013;268(3):882–9.

[17] Wu A, Peng Y, Huang B, et al. Genome Composition and Divergence of the Novel Coronavirus (2019-nCoV) Originating in China. *Cell Host Microbe* 2020;27(3):325–8.

[18] Gheblawi M, Wang K, Viveiros A, et al. Angiotensin-Converting Enzyme 2: sARSCoV-2 Receptor and Regulator of the Renin-Angiotensin System: celebrating the 20th Anniversary of the Discovery of ACE2. *Cir Res* 2020;126(10):1456–74.

[19] Das KM, Lee EY, Singh R, et al. Follow-up chest radiographic findings in patients

with MERS-CoV after recovery. Indian J Radiol Imaging 2017;27(3):342–9.

Conflict of interest -none

Ethical committee clearance -obtained