Long-Haul COVID-19: Imaging or Functional Testing?

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The first case of coronavirus disease 2019 (COVID-19) was reported in the second week of December 2019 in Wuhan, China. Since then, there have been more than 400 million reported cases, and almost six million case fatalities. Contrary to earlier thoughts, this illness may lead to a persistent pathology, now generally labelled as ‘Long COVID Syndrome’. (LCS) Various studies show that almost one-quarter to half of the COVID-19 survivors may transition to this stage, irrespective of the severity of the initial symptoms [1]. If this is correct, we may be looking at more than a hundred million patients added to the existing pool, stretching the healthcare resources even further. The number could rise, given the rapid mutation rate of the virus.

The most common persistent symptoms in the LCS are dyspnea, fatigue, chest pain and cough, all of which affect the quality of life significantly [2]. Dyspnea can be secondary to airway disease (post-COVID bronchiectasis), loss of lung parenchyma, interstitial fibrosis, pulmonary hypertension due to hypoxemia or microthrombi in the pulmonary circulation, myocardial involvement, muscle deconditioning, or dysfunctional breathing pattern, or a combination of these [3].

Most studies have found a decrease in the diffusion capacity of the lungs for carbon monoxide (DLCO), the most common abnormality in pulmonary function tests (PFTs) [4]. A 6-month-long, prospective study demonstrated a direct link between the severity of initial symptoms and a decrease in DLCO on PFT assessment [5]. However, one study demonstrated that the findings on computerized tomography (CT) scan decreased in intensity over a one-year period [6]. A reduced DLCO is directly proportional to the degree of abnormalities seen on the initial CT scan of the chest, and the presence of acute respiratory distress syndrome [7]. Patients with severe disease may have a decreased DLCO, and a decreased carbon monoxide transfer coefficient (KC0), but a normal KC0 that could help differentiate between interstitial fibrosis and loss of alveolar volume [8].

Going beyond the lung parenchyma, the in-situ thrombotic microangiopathy, secondary to immune-mediated inflammation or thromboembolism from deep veins, could be another reason for dyspnea [9]. Pulmonary hypertension may be assessed non-invasively with a 2D echocardiography (2D-ECHO). A single big clot in the pulmonary circulation may be seen in CT angiography, but the microthrombi causing flow limitation would need perfusion imaging such as ventilation perfusion (V/Q) scintigraphy or V/Q single photon emission computed tomography (SPECT) to assess for both ventilation and perfusion defects in segmental and distal circulation [10]. These studies are helpful in patients with an isolated decrease in DLCO [11].

Patients with severe acute COVID-19 disease may develop a restrictive pattern on PFTs, which results in decreased forced vital capacity (FVC), and total lung capacity (TLC). Some patients, even with mild disease, may develop a complex, restrictive pattern with a significant fall in FVC, a small fall in TLC, and an increase in residual volume (RV). This pattern is usually seen in obese people or those with neuromuscular disease. Exercise testing [6-minute walk (6MW) or short physical performance battery (SPPB)] can help differentiate pulmonary disease from deconditioning [12].

Imaging is required to assess for the structural abnormalities in patients with LCS, and the gold standard remains the CT scan of the chest [13]. Commonly reported pathologies are ground glass opacities, fibrotic-like features (e.g., parenchymal bands, irregularities at interface between parenchyma and pleura or mediastinum and traction bronchiectasis). These CT findings correlate well with functional impairment. However, unlike histological examinations, a CT scan is not diagnostic for fibrosis, as similar features may also be seen in other pathologies such as cryptogenic organising pneumonia [14]. It is also not possible to differentiate irreversible fibrosis from immature fibrosis, which may be reversible.

A lung ultrasound (LUS) may also be helpful in detecting progressive changes in the pleura and lung parenchyma, as the regions most affected are peripheral and basal. The irregularities seen may indicate pleural inflammation, and B-line artifacts may reflect interstitial edema proportional to the disease severity. Coalescent B-lines and consolidations reflect severe disease. The diaphragmatic thickness (DT) ratio and the diaphragmatic excursion (DE) abnormalities seen in LUS correlate well with ones seen on radiological imaging [15]. Although this imaging study is operator-dependent, and interpretation is subjective, the results match in accuracy with the CT scan findings [16]. The advantage of low cost, no radiation exposure, and easy portability warrant more studies for this imaging modality.

Magnetic resonance imaging (MRI) has limited use at the air-tissue interface, but low-field MRI may overcome this problem, as reported in one case report [17]. The results are comparable to CT of the chest. In addition, it can also depict ventilation and perfusion characteristics of different areas of the lungs. However, the cost, availability of this imaging modality, and transport may be an issue.
Fluorodeoxyglucose F 18 positron emission tomography/CT (F-FDG PET/CT) imaging can also demonstrate the presence of increased metabolic activity in the lung parenchyma, mediastinal and hilar lymph nodes before the appearance of clinical symptoms [18].

Further studies are needed to ascertain which imaging modality or respiratory function test is optimal in assessing these patients. We anticipate that the LCS will likely require a combination of imaging and functional testing.

REFERENCES


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