



## PERFORMING PULMONARY FUNCTION TESTS IN COVID-19 PANDEMIC

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**ABSTRACT**

COVID-19 pandemic has adversely affected the various diagnostic modalities. Pulmonary function tests (PFT) is an important investigation for diagnosis and follow up of pulmonary diseases. Performance of PFTs leads to aerosol generation. Hence, it predisposes all involved personnel like PFT technician and pulmonary physician including the patient at risk of COVID-19 infection. So, the current pandemic has lead to curtailing of PFTs. But this being an essential modality for pulmonary disease diagnosis and management, we gradually need to recommence the PFTs. In the present commentary we discuss various measures and precautions to be undertaken while performing PFTs in the current pandemic scenario.

**KEYWORDS :** COVID-19, Pulmonary Function Tests, Spirometry

COVID-19 disease had been declared as a pandemic by WHO on March 11, 2020. It has adversely affected the health care services resulting in suspension of various diagnostic modalities including laboratory based pulmonary function tests (PFTs).<sup>1</sup>

The causative virus - severe acute respiratory syndrome coronavirus 2 (SARS CoV-2), spreads by aerosol. Performance of laboratory based PFTs induces coughing and also requires high minute ventilation and flow rates. This causes aerosol generation and also the contamination of surfaces.<sup>2</sup> Therefore, PFTs pose a potential risk for spread of COVID-19 infection. This predisposes the patient, respiratory physician as well as the PFT laboratory staff for acquiring the infection.<sup>3</sup> Despite this, PFTs are an essential tool for diagnosis and monitoring of respiratory diseases. Hence, they cannot be deferred for a long time and need to be resumed but with proper precautions.

In the present commentary, we discuss the various aspects related to the precautions and procedures to be observed, while performing PFTs during the current COVID-19 pandemic situation.

**1. Patient selection**

Therefore, PFTs should not be performed as a part of routine investigation, especially in countries with current high prevalence of COVID-19.<sup>3</sup> They should be performed in a selected group of patients which may include:

- Lung or bone marrow transplantation.<sup>4</sup>
- Preoperative evaluation of urgent surgery cases.<sup>4</sup>
- Evaluation of disability and legal urgencies.<sup>4</sup>
- Patients who have recovered from COVID but have persistent changes on chest X-ray even after 12 weeks of discharge.<sup>5</sup>

**2. Which PFTs can be performed during the active pandemic period:**

In the present COVID-19 situation, if indicated, the PFTs which can be performed include pulse oximetry, arterial blood gas analysis, spirometry or lastly, diffusion capacity of the lungs for carbon monoxide (DLCO). Compared to these the PFTs which carry higher risk of spread of infection like all the bedside tests, exercise tests (like 6 minute walk test, shuttle walking test) and cardiopulmonary exercise testing should be avoided.<sup>5</sup> Also, it should be noted that spirometry with

reversibility, if required, should be performed only with patient's own inhaler with an aerosol holding chamber device (spacer).<sup>5</sup>

**3. Screening of patients:**

Screening of the patients should be done in a triage/screening area by using specifically designed questionnaire to be filled by the healthcare workers. The questionnaire should inquire about clinical symptoms of COVID-19 and history of contact with a COVID-19 case in the last 14 days.<sup>3,4</sup> Patient's temperature should be checked and if  $>37.3$  °C, the testing should be suspended<sup>5</sup> and COVID-19 testing (SARS CoV-2 RT-PCR) should be done. It is preferable to perform PFTs in suspected cases after a negative RT-PCR report is documented 48-72 hours prior to testing.<sup>5</sup> In recovered cases of COVID-19, PFTs should be performed at least 30 days after hospital discharge with a negative PCR report or 30 days after clinical recovery.<sup>3</sup>

**4. Safety Measures to be followed in PFT laboratory during COVID-19:**

The laboratory staff should follow all precautions recommended for prevention of COVID-19.<sup>5</sup> They should wear full PPE and for each patient a separate PPE should be donned. The staff should maintain adequate hand hygiene and should work in shifts. Nobody except the patient should be allowed entry in the laboratory. The technician should not demonstrate the procedure to the patient, rather it should be explained via videos or posters in the waiting room. The distance between the patient and technician should be at least 2m. Both the technician and the patient should be facing the same side during procedure and not face to face. Avoid skin contact with the patient. The test should not be performed more than twice. A gap of at least 30 to 60 minutes should be allowed (for cleaning and disinfection of equipment and room) in between patients.<sup>3</sup>

**5. Design of PFT testing room**

The testing room should be either a regular or negative pressure room situated in a separate part of the hospital. It should have minimum furniture with no carpets or curtains. It can be divided into separate patient and staff area, partitioned by plexiglass with exhaust fans installed in the patient area.<sup>6</sup> A negative pressure isolation room with 6-12 Air Changes per Hour (ACH) or side rooms with 6 ACH is encouraged.<sup>5</sup>

The exhaust air should be treated with

- i. HEPA (high efficiency particulate air) filters or
- ii. chemical disinfection with 1% hypochlorite solution or
- iii. be discharged into the atmosphere through an upward plume built at 3 m above the building's tallest point.<sup>7</sup>

Also, the room should be sanitized with UV light for at least 30 minutes a day or ozone room decontamination should be done at regular intervals.<sup>3,5</sup>

#### 6. Proper Use of PFT equipment:

Single use disposable mouth pieces and nose clip should be used.<sup>3,5</sup> In-line filters with minimum proven efficiency for high expiratory flow of 600 to 700 L/min<sup>1,3</sup> should be used. PFT equipment should be disassembled to allow physical removal of particulate matter and thereafter, cleaned with 75 % ethanol for 3 minutes twice.<sup>5</sup> The plastic mouthpiece should be cleaned thoroughly with detergent and water.

#### 7. Resumption of full PFTs:

Resumption of full operation of PFTs may occur only when the COVID-19 prevalence decreases. During the post peak phase, exercise testing and bronchial challenge tests can be gradually re-introduced.<sup>3</sup>

#### 8. Alternative methods available for management of pulmonary diseases:

Various alternative methods which can be used for managing pulmonary diseases without laboratory based PFTs include:<sup>3</sup>

- a) *Peak Expiratory Flow Meters*: They can be used for assessment of asthma control. Their role in COPD assessment is yet to be explored.
- b) *Portable Electronic Spirometers*: They can be used for monitoring of several chronic respiratory conditions, such as asthma and COPD, cystic fibrosis, idiopathic pulmonary fibrosis, and post-lung and hematopoietic stem cell transplant monitoring. But the devices are costly and they cannot be used for measuring DLCO.
- c) *Fractional Exhaled Nitric Oxide (FeNO)*: Since FeNO measurement doesn't require forceful expiration and doesn't trigger cough, it can serve as an important tool for diagnosing bronchial asthma especially during this COVID-19 era.
- d) *Airway Oscillometry*: It is also conducted under normal tidal volume and doesn't require forceful expiration, thus serving an infection control advantage over spirometry.
- e) *Novel digital health alternatives*: Pilot studies are being conducted on smartphone spirometers. They can prove to be useful in near future.

To summarize, the laboratory based PFTs need to be performed with utmost care following all precautions, triage and selection of patients till we are able to tide over this COVID-19 pandemic.

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