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Innovative score for assessment of respiratory ailments in post COVID patients

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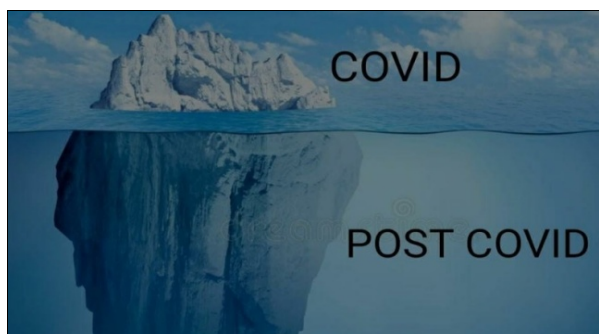
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Abstract

India being a developing country, the economic factor plays a major role in the investigations of the patients and its repeated follow up. Increasing number of post COVID patients with residual effect are reaching hospitals and their continuous assessment is important. Innovative score is developed to check the changes and improvement in condition of patient's health by reducing ionizing hazards on his body as well as cost effectiveness in place of repeated CT Scans. This article mainly focuses on assessment of respiratory element in post COVID patients by means of innovative summative scoring an economical, ubiquitous tool using Bedside Pulmonary Function Test (PFT) technique. The summative score helps in determining the assessment of Respiratory elements in a holistic way along with demonstration of evidence based clinical results.

Keywords: Post COVID, bed side PFT, Gosaw score, respiratory ailments

Introduction



COVID pandemic has a long lasting effect on society in terms of health & economy. COVID effects the overall health of individual including physical as well mental plane. Since COVID affects nearly all system of body yet it's impact on respiratory system is more so there is the need for a summative score to quantify the assessment of respiratory ailments.

A report published recently, portrayed that discharged patients with COVID-19 pneumonia still have residual abnormalities in chest computed tomography (CT) scans, with Ground-Glass Opacity as the most common pattern^[1]. Persistent impairment of pulmonary function and exercise capacity have been known to last for months or even years^[2-5] in the recovered survivors from other coronavirus pneumonias like Severe Acute Respiratory Syndrome (SARS) and Middle East Respiratory Syndrome (MERS).

It is observed in discharged survivors of COVID-19, impairment of diffusion capacity is the most common abnormality in lung function, followed by restrictive ventilatory defects, which are both associated with the severity of the disease.

Recent studies reveal that the lung is the organ most affected by COVID-19^[6,7], with pathologies that include diffuse alveolar epithelium destruction, capillary damage/bleeding, hyaline membrane formation, alveolar septal fibrous proliferation, and pulmonary consolidation. Previous studies have demonstrated that recovered patients with coronavirus pneumonia can be left with damaged lungs. Impaired lung function was common and could last for months or even years.

In the follow-up studies lasting 0.5-2 years in rehabilitating SARS patients [6, 7], impaired D_{LCO} diffusing capacity of the lungs for carbon monoxide was the most common abnormality, ranging from 15.5% to 43.6%, followed by defective TLC, ranging from 5.2% to 10.9%.

Assessments of respiratory system



Fig 1: Methods to assess respiratory systems

Routine method of assessment of respiratory systems include following step

1. Clinical Examination Of Respiratory System –
 - Respiratory Rate
 - type & pattern of respiration
 - shape and size of chest
 - use of accessory muscle
2. Blood investigation – arterial blood gas (ABG)
3. Radiological investigation – chest X ray and/or HRCT scan
4. Special – pulmonary function test, pulse oximetry, capnography, diffusion lung test

Looking to the large number of patients & their economic condition, it is necessary to develop an alternate & innovative method to assess respiratory ailments which would essentially be

1. Easy to apply bed side measure.
2. Easy to interpret.
3. Objective in nature.
4. Reproducible.
5. Without financial constraint.
6. Non-invasive.
7. Without any ionizing hazards.
8. Avoiding machine dependency.
9. Without a technician need.

Due to COVID-concern for contamination of equipment's, Transmission of contagious diseases etc is considered.

After the emergence of COVID-19, most pulmonologist believe that use of PFT should be limited. In India use of PFT is already very less but bedside pulmonary function test is forgotten due to emergence of multiple techniques. Bedside pulmonary function test (PFT) can be easily done besides the patient maintaining his/her comfort and ruling out the need for other mechanical investigations. We have judiciously chosen the understated investigations based on

the specified features associated with them:

Salient features of proposed pulmonary function test

Group of procedures involved to measure the functions of the lungs;

1. Spirometry.
2. Lung volumes.
3. Gas transfer.
4. Bronchial challenge.

Pulmonary function tests is a general term used to indicate a series of maneuvers or investigations that are performed, to measure lung functions. It evaluates one or more aspects of the respiratory system

- Pulmonary parenchymal function/ Gas exchange (size & integrity of the pulmonary capillary bed).
- Respiratory mechanics.
- Cardiopulmonary interaction.

Although they do not provide a diagnosis as such, nevertheless the abnormalities as observed in the tests performed aid in establishing the diagnosis.

Indications of PFT

1. Assessment of signs & symptoms like breathlessness, chronic cough, exertional dyspnea to encounter the disease.
2. Evaluate the extent and assess severity of disease.
3. Screening at risk patients and follow their response to therapy.
4. Compute the consequences of drugs on pulmonary function.
5. Estimate preoperative risk.
6. Detect pulmonary drug toxicity.
7. Monitor individuals vulnerable of having pulmonary diseases.
 - a. Smokers.
 - b. Individuals employed in exposures to deleterious substances.
8. Determine prognosis (lung transplant, etc.)
9. Appraise health status prior to enroll in strenuous physical activity programs.
10. Evaluate therapeutic interventions.
 - a. Bronchodilator therapy.
 - b. Steroid treatment for asthma, interstitial lung disease, etc.
 - c. Other (antibiotics in cystic fibrosis, etc.)
 - d. To monitor for adverse reactions to drugs with known pulmonary toxicity.
11. Evaluate patients as element of a rehabilitation program.
 - a. Medical.
 - b. Industrial.
 - c. Vocational.
12. To assess risks as part of an insurance evaluation.

So to evaluate the extent and assess severity of disease we employ bedside PFT

Bedside PFT test includes

1. Greene and Berowitz cough test.
2. Olsen modified match test / Snider's match blowing test.
3. Sabrasez Breath holding test.

4. Auscultation over trachea.
5. 6 min walk test.

Greene and Berowitz cough test

The patient should take up a deep breath in accordance with cough. The ability to cough determines the durability and efficacy of the respiratory muscles. A competent cough would warrant a Vital Capacity equivalent to 3 times Tidal Volume. If he is impotent to do so, his Forced Vital Capacity of < 20 ml/min, FEV1 < 15ml/kg and PEFr < 200ml/min can be extrapolated.

If the patient undergo a wet productive cough or has paroxysms of coughing, he is susceptible to post-operative pulmonary complications.

Olsen modified match test/Sneider's match blowing test

This measures the Maximum Breathing Capacity.

If patient with mouth wide open can blow match stick from a distance of 6 inch or 15cm, his chin should be rested or supported on stationary surface or by is hand, with no purse liping and head movement. The air movement in the room should be negligible and level of mouth and match should be uniform.

6 attempts should be designated to the patient before interpretation of actual test.

If the patient could blow match, his MBC > 60L/min and with a FEV1 > 1.6L and if unable to do so, then vice versa.

The modified Match stick test by Olsen, assist us to estimate the MBC by establishing a relationship between the distance at which the match stick is blown out and the MBC of the patient. A distance of

- 9 inch predicts an MBC of 150 L/min
- 6 inch predicts an MBC of 60 L/min
- 3 inch predicts an MBC of 40 L/min

Sabrsez breath holding test

Earliest note on the significance of Breath holding test as a marker of cardiopulmonary function was made by Sarbare's of Bordeaux^[8]. He found the average normal voluntary apnoeic interval (between breaths) while tidal breathing to be from 20 to 25 seconds in duration; while an interval of 30 to 35 seconds was exceptional^[8].

Instructions given by Yandell Henderson to perform breath holding test are^[8].

- Sit quiet for 5 minutes.
 - Take a full but not too deep breath.
 - Hold it with mouth and nostrils closed.
 - Note time in seconds.
- a) By breath holding test we can interpret cardiopulmonary reserve & vital capacity of lung^[9] interpretation of sabrsez breath holding test
 - If a person can hold breath for 25 seconds, it is standard cardiopulmonary reserve and his lung capacity is customary.
 - If hold for 15 to 20 seconds than his cardiopulmonary reserve capacity is restricted.
 - At last, if he even cannot hold for 15 seconds, his cardiopulmonary reserve is miserable.
 - b) The length of time can crudely help to quantify the Vital capacity of the patient.
 - In Case, person can hold breath for 25 to 30 seconds his vital capacity is 3500 ml.
 - If hold for 20 to 25s, vital capacity is 3000 ml.
 - If hold for 15 to 20s, vital capacity is 2500 ml.
 - If hold for 10 to 15s, vital capacity is 2000 ml.
 - If hold for 5 to 10s, vital capacity is 1500ml.

Auscultation over trachea

In this test, patient should embrace deep breath and to exhale it maximally and forcefully. Stethoscope should be kept on his trachea and exhalation sounds must appreciated. Normally the sounds are heard for 3-5 s. If < 3 s, then a restrictive type of disease may be present and > 6 s, then an obstructive lung disease may be present.

6 Minute walk test

Patient should walk for 6 minute and had to cover atleast 2000feet distance during this period of time and SPO2 is measured before and after walk. Change in SPO2 reading is noticed, if decrease in SPO2 > 4, then it is usually corresponds to lung involvement.

Table 1: A common score is made from above 5 test

Gosaw score	Score 0	Score 1	Score 2
Greene and Berowitz cough test	Able to cough	Not able to cough	Productive/ paroxysm
Olsen modified match test / Snider's match blowing test	9"	6"	3"
Sabrsez breath holding test	More than 20 sec	20- 15 sec	Less than 15 sec
Auscultation over trachea	4-5 sec	2-3 sec/ 5-6 sec	Less 2 sec/more than 6 sec
6 min walk test	No change / increase	1-4 fall	More than 4 fall

Score minimum score 0 maximum score 10

- Score < 3 – assurance and treatment
- Score 3-6 – treatment and follow up
- Score >6 – treatment and monitoring, may require hospitalization also.

Conclusion

This assemblage of 5 bedside PFT tests, developed as GOSAW score can be used for assessing severity of disease, prognosis & response to treatment in post COVID patients very effectively particularly in central India. So in future before going for chest X-ray, CT Scan etc. for evaluation of respiratory system we can use proposed clinical test with this scale. It will be instrumental in enhancing the role of detailed clinical assessments before moving to exposure or

invasive investigations. Due to the varied and ambiguous novel presentations post COVID, this approach can be a landmark mode of clinical assessment, with minimized chances of missing respiratory symptom cluster.

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