



STUDY OF EFFICACY OF FORCED EXPIRATORY TIME AS A SUPPORTIVE DIAGNOSTIC TEST IN CASES OF CHRONIC OBSTRUCTIVE PULMONARY DISEASE

General Medicine

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ABSTRACT

Background: Chronic Obstructive Pulmonary Disease (COPD) is a common, preventable, and treatable disease characterized by persistent respiratory symptoms and progressive airflow limitation due to airway and alveolar abnormalities usually caused by significant exposure to noxious particles or gases and influenced by host factors. The present study aimed to diagnose Chronic Obstructive Pulmonary disease using Forced expiratory time as a supportive diagnostic test and correlating with spirometry findings. **Materials & Method:** The present comparative study was conducted at the Department of General Medicine, AVMC&H, among patients aged 45 to 70 years diagnosed with mild to moderate-grade COPD. A detailed history, clinical assessment, and laboratory diagnosis were made, and forced expiratory time were calculated below. The patient was made to sit comfortably, and a forced expiratory maneuver was demonstrated to them. They were asked to inhale as quickly and as completely as possible. A stethoscope bell was positioned over the upper trachea in the suprasternal notch for auscultation during expiration and was timed with a stopwatch. The test was repeated at least three times, and the mean of the three readings was taken. The values were compared with spirometry findings. All data were collected and analyzed using Karl Pearson Correlation to find the study's significance level. **Results:** A total of 150 patients were included, with a mean age of 58.71 years; 62.7% were male, and 37.3% were female. A significant difference between the mild and moderate grades of COPD. The forced expiratory time was significantly higher among the moderate COPD (7.02±1.09) than mild COPD (4.5±0.51). The Spirometric parameters were significantly lower among the patients with moderate COPD than those with mild COPD. (p<0.05) There is a significant negative correlation between forced expiratory time with Spirometric parameters. (p<0.05) On comparison of the comorbidities with the forced expiratory time, there is no significant difference between the groups. (p>0.05) **Conclusion:** The present study showed a significant correlation between the forced expiratory period and COPD severity.

KEYWORDS

Chronic Obstructive Pulmonary Disease, Forced Expiratory Time, Diagnostic Test, Pulmonary Disease.

INTRODUCTION

Chronic Obstructive Pulmonary Disease (COPD) is a common, preventable, treatable disease characterized by persistent respiratory symptoms and progressive airflow limitation due to airway and alveolar abnormalities usually caused by significant exposure to noxious particles or gases and influenced by host factors.^{1,2} The obstruction is usually progressive and associated with an abnormal inflammatory response of the lungs to noxious particles and gases. The mechanism involved is complex; airflow obstruction can be mainly attributed to a marked increase in airway resistance secondary to a variable mix of structural abnormalities involving all compartments of the airway. COPD is one of the most important causes of morbidity and mortality worldwide.³

Airway obstruction is a disproportionate reduction of forced expiratory volume in the first second (FEV1) compared to the forced vital capacity (FVC) during a spirometric test.⁴ Spirometry can objectively document the presence of an obstructive ventilatory defect; it requires technical expertise in performing tests and equipment calibration and maintenance. It is not available in many parts of our country, leading to increased morbidity and mortality.⁵

Forced Expiratory Time is the time the individual takes to complete a forceful exhalation after maximal inspiration.^{4,6} This test is quickly done, can be added to routine physical examinations, and provides results comparable to the time calculated on spirometry.^{7,8} Spirometry is considered a confirmatory test in diagnosing obstructive airway disease.⁷ Forced expiratory time is used as a supportive diagnostic test in cases of COPD, and it is correlated with spirometry findings.⁹⁻¹² This present study aimed to assess the efficacy of Forced Expiratory Time in diagnosing COPD and correlating with spirometry findings.

MATERIAL & METHOD

This comparative diagnostic study was done over a period of two years on hospitalized and outpatients with the diagnosis of COPD in the Department of General Medicine, AVMC&H. Patients with end-organ

failure and severe anemia were excluded from the study. After obtaining informed and written consent from the patients, detailed history, clinical assessment, and laboratory investigations were done. Forced expiratory time was calculated as mentioned below. Patients were made to sit comfortably, and forced expiratory maneuvers were demonstrated.

They were asked to inhale as quickly and as completely as possible. A stethoscope bell was positioned over the upper trachea in the suprasternal notch for auscultation during expiration and was timed with a stopwatch. The test was repeated at least three times, and the mean of the three readings was taken. The values were compared with spirometry findings.

Statistical analysis

The mean difference between continuous variables was tested using an unpaired t-test, and the strength of association was analyzed using Karl Pearson's Correlation between the FET and Spirometry findings. The diagnostic validity of the test methods was compared using sensitivity and specificity, ROC curve, and AUC analysis. A p-value of <0.05 was considered statistically significant, and statistical analysis was performed using SPSS v28 operating on Windows 10.

RESULTS

In the present study, a total of 150 patients fulfilling inclusion criteria with a mean age of 58.71 years were included. Among them, 62.7% were male, and 37.3% were female patients, with male preponderance in the study. Among the study participants, 38.7% had diabetes mellitus, 36% were hypertensive, and 4.7% had a history of hypothyroidism. Among the study participants, 32% were non-smokers, and 68% were smokers.

Among smokers, 47.3% were current smokers, 12.7% were ex-smokers, and 8% were passive smokers. (Table I) On the assessment of the history of indoor pollution, 50.7% had a presence, and 49.3% with no indoor pollution. In the present study, 88% of the patients had a moderate grade of COPD, and 12% had a mild grade of COPD.

Table I.: Comparison of the characteristics with COPD grade.

PARAMETERS	COPD				p-value
	Mild		Moderate		
	Mean	SD	Mean	SD	
Forced Expiratory Time	4.50	.51	7.02	1.09	0.01*
FVC	2.95	.34	2.48	.47	0.01*
FEV1	1.92	.29	1.56	.33	0.01*
FEV1/FVC	64.23	3.92	62.49	4.35	0.110
FEV1 of predicted	84.20	3.12	58.70	7.54	0.01*

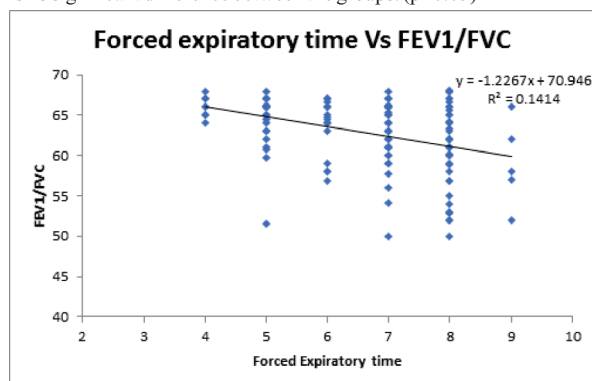
On the assessment of the forced expiratory time and spirometry parameters, we found a significant difference between the mild and moderate grades of COPD. The forced expiratory time was significantly higher among the moderate COPD (7.02 ± 1.09) than mild COPD (4.5 ± 0.51). The Spirometric parameters were significantly lower among the patients with moderate COPD than patients with mild COPD. ($p < 0.05$) COPD – Chronic Obstructive Pulmonary Disease, FVC – Forced vital capacity, FEV1 – Forced expiratory volume in 1 second

Table II: Correlation of spirometry measurements with forced expiratory time using Pearson's correlation

PARAMETERS	Forced Expiratory Time	
FVC	R	-.578**
	Sig.	.000
FEV1	R	-.654**
	Sig.	.000
FEV1/FVC	R	-.376**
	Sig.	.000
FEV1 of predicted	R	-.807**
	Sig.	.000

There is a significant negative correlation of forced expiratory time with Spirometric parameters. ($p < 0.05$) FVC – Forced vital capacity, FEV1- Forced expiratory volume in 1 second.

On assessing the forced expiratory time and spirometry parameters, we found a significant difference between the mild and moderate grades of COPD. The forced expiratory time was significantly higher among the moderate COPD (7.02 ± 1.09) than mild COPD (4.5 ± 0.51). The Spirometric parameters were significantly lower among the patients with moderate COPD than those with mild COPD. ($p < 0.05$) On the correlation of forced expiratory time with Spirometric parameters, there is a significant negative correlation present. ($p < 0.05$) On comparison of the co-morbidity with the forced expiratory time, there is no significant difference between the groups. ($p > 0.05$)

**FIG 1: Correlation of Forced expiratory time with FEV1/FVC**

This figure shows the negative correlation between FEV1/FVC and FVC. FEV1- Forced expiratory time in 1 second, FVC – Forced vital capacity, FET – Forced expiratory Time.

DISCUSSION

Chronic Obstructive Pulmonary Disease (COPD) is a common, preventable, treatable disease characterized by persistent respiratory symptoms and progressive airflow limitation due to airway and alveolar abnormalities usually caused by significant exposure to noxious particles or gases and influenced by host factors.^{1,2}

The Spirometric parameters were significantly lower among the patients with moderate COPD than patients with mild COPD. ($p < 0.05$)

There is a significant negative correlation of forced expiratory time with Spirometric parameters. ($p < 0.05$) On comparison of the comorbidities with the forced expiratory time, there is no significant difference between the groups. ($p > 0.05$)

Similar to the present study, Singh U et al. concluded that the Forced expiratory time could be used as a supportive test, and if the Forced expiratory time comes out to be more than 7 seconds, then initiate treatment as per GOLD guidelines to minimize the symptoms.⁷ Wali O et al. documented that compared to simple spirometry, forced expiratory time at a cut-off value of ≥ 6 seconds showed a sensitivity of 61% and a specificity of 79% in predicting obstructive airway disease.¹⁴

On multivariate analysis by Straus SE et al., only three clinical examination features were substantially linked with the diagnosis of COPD: self-reported history of COPD (adjusted LR 4.4), wheeze (adjusted LR 2.9), and FET more than 9 seconds (adjusted LR 4.6). The model including these three components had an area under the receiver operating characteristic curve of 0.86. In the diagnosis of COPD, the existence of isolated symptoms or indicators should be emphasized. While various clinical examination aspects are related to COPD diagnosis, only three are significant in multivariate analysis.¹⁵

Like the present study, FET measures were repeatable and inversely linked with forced expiratory volume in one second (FEV1), FEV1/forced vital capacity, and peak expiratory flow.⁷

Similar to the present study, FET measures were repeatable and inversely linked with forced expiratory volume in one second (FEV1), FEV1/forced vital capacity, and peak expiratory flow.¹⁵ The study findings are significant and demonstrate FET's utility in a limited resource setting. The study findings can be strengthened by conducting on a larger population and extending to a more extensive multicentric study.

CONCLUSION

The current study's findings showed a statistically significant difference in mean forced expiratory time among COPD patients and a statistically significant link between the grade of COPD. It was shown that there was a strong correlation between the forced expiratory time and the changes in spirometry. A supplemental diagnostic test called the forced expiratory time may be utilized to diagnose COPD and assess its severity.

Declarations

Conflict of interest: None

Ethical approval: The study was approved by the Institutional Ethics Committee

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