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FORCED EXPIRATORY TIME VIS-À-VIS SPIROMETRIC EVALUATION OF DIAGNOSING AIRWAY OBSTRUCTION

Community Medicine

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ABSTRACT

Spirometry, a useful investigation to diagnose airflow obstruction in humans has constraints of its lesser availability in resource constrained public health delivery settings, such as in India. Forced expiratory time (FET) is an alternative tool, which has been documented in many studies globally, to detect airflow obstructions with equal efficacy to spirometry. The present study was evolved with the objective of documenting the utility capability of FET technique. 120 patients of a Medical College in Himachal Pradesh, a northern hilly state of India, were enrolled for the study. FET was observed by trained physician and Forced expiratory volume in one second (FEV1) and forced vital capacity (FVC) were measured by spirometry. A two factorial Randomized Block Design study was formulated by considering six treatment combinations (three levels of FEV1 and two levels of FET) and 20 replications (patients) in each group of COPD and non COPD patients. FET of less than 5 seconds was significantly found to detect severe airway obstruction of less than 50%. The study documented that FET can be a useful diagnostic tool for diagnosing airway obstruction even at grass root levels of public health delivery where spirometry is unavailable.

KEYWORDS

Forced expiratory time, utility, spirometry, airway obstruction

INTRODUCTION:

Chronic obstructive pulmonary disease (COPD) is a progressive lung disease that causes breathlessness initially with exertion and later on leads to serious life threatening illness. The disease develops slowly and usually becomes apparent after 40 or 50 years of age. About 251 million cases of COPD were reported in 2016 globally and 90% of deaths attributed to COPD have occurred in low and middle income countries [1]. COPD is not curable but treatment can relieve symptoms and improve the quality of life. Airway obstruction is the inherent component of the disease and leads to persistent reduction of airflow in the lungs which implicates as breathlessness at exertion initially and later on worsening to breathlessness even at rest. Documentation of airflow obstruction, henceforth, is an important tool which assists in the prompt diagnosis of the disease.

Spirometry, a worldwide acclaimed breathing test is being used for diagnosing COPD. It measures how much and how quickly a person can exhale air. The spirometric evaluation defines airflow obstruction as a disproportionate reduction of forced expiratory volume in the first second (FEV1) in relation to the forced vital capacity [2]. The test thus objectively documents the presence of a ventilatory defect in a person which certainly is advantageous over the subjective explanation of the airflow obstruction symptoms by the person. However, spirometry is an expensive investigation entailing technical expertise for documentation of results, equipment maintenance and calibration. The overall high cost of spirometric evaluation makes its availability and applicability a rare entity especially in resource constrained settings. In Himachal Pradesh, a northern hilly state of India the test is even not available at the secondary public health institutes of the region. On the contrary, the wide prevalence of COPD in the state [3], which is predominantly a rural base population, poses a diagnostic challenge of the disease at the primary health care level. Henceforth, there is an utmost need of a diagnostic test which can easily be put into practice even at the grass root level health providing institutes.

In the past, various methods such as blowing out candles, blowing out matches, whistling etc have been employed elsewhere as surrogate tests for spirometry for screening the airflow obstruction. These tests were inadequately standardized and proved as poor markers for the condition [4]. Forced expiratory time, a method of auscultation of tracheal sounds has been proposed for about 50 years now, as an effective tool for eliciting airway obstruction. This test is simple to perform and does not require additional infrastructure. The test can be easily put into place in the routine examination of the patients as it does not entail much time for its execution and provides result comparable to the time calculated on spirometry [5,6]. The result of the test correlate well with the other measures of airflow limitation and is a highly reproducible method [7, 8, 9]. Variable diagnostic accuracy at different threshold timings of the test have been documented in several investigation [10, 11, 12]. A threshold of 6 seconds is widely used in this method [6]. We conducted a study in a tertiary care hospital of the state to substantiate the utility of FET in detecting airway obstruction.

Methods: A prospective interventional study was conducted after securing permission from the ethics committee of the medical college. An informed consent was obtained from the participants. A total of 120 voluntary participants with informed consent were enrolled. History of smoking was elicited from them. The participants were demonstrated the forced expiratory maneuver. Thereafter, they were asked to inhale deeply followed by a forced exhalation with mouth wide open as quickly and as completely as possible. FET was measured by the principal investigator by placing the stethoscope over upper trachea in the suprasternal notch of the participants. Spirometry was carried out by trained technicians. FEV1 and FVC were measured by spirometry as per the standard guidelines. The results of FET and spirometry were kept blind folded. FET and FEVI/FVC were considered as two factors. Three levels of the factor FET were considered namely < 5, 5-7 and > 7 seconds. Whereas, the two levels of the factor FEV1/FVC were < 0.7 and ≥ 0.7 (COPD, the obstructive lung disease and non COPD cases, the non obstructive lung disease respectively). Accordingly, six treatment combinations were formulated (three FET levels X two FEV1/FVC levels) which were replicated 20 times i.e 20 persons under each level of FET were evaluated for FEV1 in both the groups of COPD and non COPD patients. Thus a total of 120 persons were analyzed under the Factorial Randomized Block Design (RBD) by following the procedure suggested by Gomez and Gomez [13]. The

treatment means were compared by critical difference (CD) at 5 per cent level of probability. The correlation analysis was done by using the SPSS software version 21.

RESULTS:

Both the groups i.e. COPD (FEV1/FVC <0.7) and non COPD (FEV1/FVC ≥ 0.7) had 37 men and 23 women each. The mean age of men and women in the COPD group was 46.5 ± 12.2 and 42.2 ±10.1 years respectively. Whereas, the mean age was 47.1± 11.2 and 42.32 ± 10.0 years respectively for men and women in the non COPD group.

A strong positive correlation (r = 0.9) existed between the FET and FEVI in both the groups of COPD and non COPD patients. Moreover, a strong correlation of smoking (r = 0.8) was also observed with FEV1 in the COPD group and a moderate correlation (r = 0.3) in the non COPD group.

Severe airflow obstruction (Post bronchodilator FEV1 < 50%) of 38.70 % was noticed in the COPD patients who had recorded FET of < 5 seconds. Whereas, FET < 5 seconds was also observed in non COPD patients having moderate air flow obstruction of 55.10 %. The FET of less than 5 seconds was significantly found in severe airway obstruction with mean FEV1 value of Overall, FET < 5 seconds was significantly

Table 1. Airflow obstruction variations depicted by FEV1 elicited by FET in COPD and non COPD patients

FET (seconds) FEV1 (%)	FEV1/FVC < 0.7 (COPD group)	FEV1/FVC ≥ 0.7 (Non COPD group)	Mean FEV1 (%)
< 5	38.70	55.10	46.90
5 – 7	84.10	47.40	65.75
> 7	75.60	113.50	94.55
C D (0.5) FET FEVI/FVC FET x FEVI/FVC	1.66 1.36 3.47		

Table 2. Analysis of Variance

Source of Variation	Degree of Freedom	Sum of Squares	Mean Squares	F-Calculated	Signficance
Replication	19	234.133			
Factor A-FET	2	46,070.467	23,035.233	1,642.574	0.00000
Factor B-FEV1/FVC	1	1,032.533	1,032.533	73.627	0.00000
Interaction A X B	2	29,490.067	14,745.033	1,051.425	0.00000
Error	95	1,332.267	14.024		
Total	119	78,159.467			

recorded (Table 2) in patients having severe airflow obstruction with mean FEV1 of 46.90 %.

The data illustrated in Table 1 also demonstrated that FET of 5 to 7 seconds was observed in COPD patients having mild air flow obstruction with FEV1 = 84.10 % and in non COPD patients having severe obstruction with FEV1 = 47.40. Overall the FET of 5 to 7 seconds was significantly found in moderate airway obstruction depicted by FEV1 value of 65.75 %. However, it was also inferred from the Table 1 that the mild airflow obstruction depicted by FEV1of 94.55 % was elicited by FET of more than 7 seconds.

DISCUSSION:

The study demonstrated that there is a strong association between the FET measured and the FEV1 observed. Similar findings have been observed in studies conducted elsewhere (Straus *et al*., 2002 [14] and Mattos *et al*., 2009 [15]). The present study also evinced that FET of less than 5 seconds was significantly able to demonstrate the severe airway obstruction of post bronchodilator FEV1 of less than 50 %. The findings are in corroboration with the results of Wali (2011) [16] and Deeks (2004) [17]. It was also observed that there was comparatively lesser capability of FET of more than 5 seconds to detect severe airway obstruction. FET of more than 5 seconds was however, able to elicit the moderate and milder airway obstruction. The FET of less than 5 seconds detecting airway obstruction has also been documented in a study in the region adjoining the present study area (Aggarwal *et al*., 2018)[18].

CONCLUSION:

The present study has documented the capability of FET in diagnosing the airway obstruction diseases. The FET can be used as a diagnosing tool for airway obstruction diseases, even at the grass root level where costlier investigations like spirometry are unavailable.

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