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An Easy Method of Spirometry for Ill and Aged Subjects

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Abstract- Recording og forced eexpiration from tidal breathing referred to as forced expiratory capacity (fec) and its volume for first sec. Referred to as (fec1) appears to be a simple convenient technique than the conventional forced vital capacity manuevre(fvc). From fec tracings volume expelled for the first sec and its % can be measured (fec1%) such spirometric recording obtained from tidal breathing to residual volume may be referred to as spirometric recording at low lung volume. Asthmatics and old subjects find this manuevre easier to perform than the conventional manuvre of forced vital capacity (fvc)

fec recording offers no discomfort to subjects as it does not involve maximal inspiration before forced expiratory effort in its procedure as seen in conventional spirometry recording of FVC. FEC recording is a simple, reliable and sensitive test for evaluation of early airway obstruction in asymptomatic smokers and therefore may be utilised in clinical and epidemiological survey.

I. INTRODUCTION

Fvc manuvere has been widely recognized as an important ventilaory spirometric tracing for evaluation of airway obstruction (tiffeneau1976) but bronchoconstriction after deep inspiration becoming a common feature of asthma has been demonstrated(by naddetal1961, butler 1960 and gimenoetal 1972). Also in asthmatics and copd maximal inspiration reduces the bronchial patency (herxheimer et al 1946). Therefore the functional studies of asthmatics is biased by the conventional technique of fvc recording (gayrard et al 1975)

There is increasing emphasis on the need for detection of airway obstruction at an early stage. Airways <2mm in diameter are the sites where obstuction process begin first. Because of the large total cross sectional area of these smaller airways, considerable increase in resistence is required before forced expiratory volume for first sec. And its %(fev1 &fev1%) obtained from fvc recording becomes abnormal and mostly patients with presumed disease of smaller airways will have normal fev1 and fev1% (morris et al 1975;morris 1976) therefore conventional spirometric tracings of fvc, fev1 and fev1% is insensitive to small airway disease. Flow abnormalities in these smaller or peripheral airways may be well appreciated if spirographic tracings are made at low lung volumes (richard et al 1975) in the present study an attempt was made to record forced expiration at low lung volume without maximal inspiration ie forced expiration to rv from tidal breathing. the forced volume (fec) corresponds to tidal volume (tv) and forced expiratory reserve volume (ferv) and volume expelled for the first sec) and its % is referred to as fec1 and fec1%. This recording has been found to be useful for early detection of small airway disease in asymptomatic smokers.

II. MATERIALS AND METHODS

The study included totally 3 group of subjects. 1st group comprised of 62 healthy normal subjects (39 males &23 females) between 18—35 years of age with the mean age of 25 years, who are non-smokers and not having any cardiac and respiratory disease and no persistent cough with no history of recent respiratory illness and no occupational history of exposure to dust or fumes.

11nd group included 73 asthmatics (41malesand 32 females) with the history of episodic attack of acute airway obstruction resolving spontaneously or on treatment with BD, with persistent minimal or little disability in between and with absence of any cardiovascular disease. Among them16 were as diagnosed as having Bronchitis and 6 having chronic bronchitis with emphysema .Their ages ranged from 22-62 yrs with the mean age of 42.8 yrs. The reversibility of their airways were checked with spirographic tracings recordings before and after BD therapy.

111rd group comprised of 2 sub groups - of smokers and non-smokers. Smoker group included 22 male subjects with the smoking history of >10 cigarettes/ day for more than a minimum of 5 yrs to a maximum of 7 yrs who are asymptomatic with no persistent cough and no exertional dyspnoea. Their ages ranged from 18-40 yrs with the mean of 31 yrs.

2nd set of sub group comprised of equal number of normal subjects of similar age group, body build and with no cardiovascular disease who are non-smokers were selected for the study.

Conventional Spirometric recordings, its volume for first sec, and its percentage ie (FVC, FEV1 FEV1%) so also FEC, FEc1 AND FEC1% FROM TIDAL BREATHING WITHOUT DEEP INSPIRATION BEFORE FORCED EXPIRATORY FLOW WAS ALSO MEASURED FOR ALL THE SAME subjects. FEFR 75 was recorded from FVC tracings.

The pre and post BD effect were evaluated for patients with airway obstruction by making them inhale two breaths of Salbutamol 100 micrograms /puff from pressurized canister for a total dose of 200 micrograms. The two puffs were taken at 1-2 mints interval starting below FRC and continuing to TLC and holding the breaths for 10 secs. Within 15-20 mints after BD therapy pulmonary function studies were repeated.

III. RESULTS &OBSERVATIONS

Mean values of FVC recordings (FVC,FEV1 &FEV1%) of Group1 were compared with those of FEC recordings(FEC,FEC1,FEC1%) inTable1.

The normal patency exhibited by FEV1 and FEV1% has been clearly brought out by similar results obtained with FEC1

and FEC1%. And FEC1 shows a significant correlation with FEV1 ($p<01$)

The degree of airway obstruction shown by a fall in FEV1and FEV1% in GROUP11 has been equally well demonstrated to the same degree by similar fall in FEC1 and FEC1% (in Table4.)

FEC1% is almost the same as FEV1% in females. Whereas FEC1and % is much more reduced in males as the flow recording at low lung volume reflects the greater proportion of total airway resistence contributed by small airway disease.(table 2) % of improvement with BD therapy is shown in Table 4 for asthmatics in which the significant improvement seen in FVC,FEV1 &FEV1% after BD correlates well with the improvement shown by FEC, FEC1&FEC1%. BD has been found to be not very effective in reversing the broncho constriction in chornic bronchitis and COPDS (.table5)

Mean FEV1 and FEV1% of asymptomatic smokers (subgroup1) and non-smokers (subgroup11) of Group111 are found to be normal and almost the same. Whereas FEC1 and FEC1% of smokers (subgroup1) is significantly reduced ($p<.05$) compared to that of non-smokers (subgroup11) and FEFR75 obtained from conventional spirometry is also reduced in smokers compared to non-smokers (Table3) .

IV. DISCUSSION

Lim and Omeha1972 and Lim 1973 pointed out the usefulness of spirometric recording at low lung volume for early detection of stasis of peripheral airways. The resistance offered by smaller airways increasing sharply at lower distending volume and pressure of the lungs has been demonstrated by Morris 1975 and Richard et al 1975 Similarly a fall in FEF75 in patients with small airway disease had also been documented by Hill et al 1972.Significant reduction in FEF75 in smokers illustrating the involvement of smaller airways has been already reported (Morris 1975, Maloet.al 1975).

Reduction in FEC1 and its % in smokers observed in the present study confirm the diagnosis of smaller airway involvement in these smoker subjects.

Hence it may be concluded that recording at low lung volume is a simple but most reliable sensitive test for epidemiologic survey for screening large population for prevalence of small airway disease .It produces no discomfort, provides equally all and more informations obtained from FVC maneuver and therefore may be applied for evaluating geriatric and asthmatic patients for routine check up in pulmonary function laboratories.

TABLE-1
MEAN SPIROMETRIC VALUES—GROUP1

	CONVENTIONAL			NEW METHOD		
SEX	FVC(LIT)	FEV1(LIT)	FEV1%	FEC(LIT)	FEC(LIT)	FEC1%
MALE(39)	4.17	3.68	88.2	1.80	1.58	87.7
SD	0.40	0.30	7.0	0.15	0.12	9.0
FEMALE(23)	3.60	3.18	88.4	1.33	1.18	88.6
SD	0.39	0.30	6.0	0.19	0.13	7.5

TABLE 2
VENTILATORY INDICES IN OBSTRUCTIVE PATIENTS—GROUP11

	CONVENTIONAL			NEW METHOD		
SEX	FVC	FEV1	FEV1%	FEC	FEC1	FEC1%
MALE(41)	2.55	1.94	76	1.42	0.95	66.8
SD	O.43	0.31	5.3	0.26	0.16	8
FEMALE(32)	1.70	1.26	74.4	0.91	0.67	73.8
SD	0.41	0.32	5.1	0.16	0.15	7.5

TABLE—3
PULMONARY FUNCTION TESTS FOR SMOKERS AND NON-SMOKERS- GROUP111

INDICES	UNITS	SMOKERS MEAN	SD	NON-SMOKERS MEAN	SD
FVC	LIT	3.69	0.44	3.82	0.51
FEV1	LIT	3.24	0.41	3.33	0.55
FEV1%	%	88	5.52	87	5.71
FEFR75	LIT/SEC	0.9	1.41	2.24	0.89
FEC	LIT	1.2	0.48	1.67	0.36
FEC1	LIT	0.98	0.31	1.39	0.30
FEC1%	%	82.7	12.7	83.4	11.7

TABLE—4
EFFECT OF BD IN ASTHMATICS (51NOS)
GROUP11—SUB GROUP 1

INDICES	UNITS	PRE BD	POST BD	% RESP	P.VALUE
FVC SD	LIT SD	2.95 SD	3-13 SD	10	NS
FEV1	LIT	1.70 0.20	2.29 0.18	22	0.05
FEV1%	%	59 7	72 6	9	0.05
FEFR75	L/S	0.05 0.02	0.97 0.40	23	0.05
FEC	LIT	1.11 0.08	1.96 0.91	22	.01
FEC1	LIT	0.15 0.075	1.12 0.89	17	.01
FEC1%	%	76.6 7	71.8 11	11	0.01

TABLE 5
GROUP11---SUB GROUP11
EFFECT OF BRONCHODILATOR IN COPDS—22NOS
(16-CHRONIC BRONCHITIS & 6 EMPHYSEMATICS)

INDICES	UNIT	PRE BD	POST BD	% RESPE	P VALUE
FVC SD	LIT	2.65 0.22	2.85 0.26	11	NS
FEV1 SD	LIT	1.32 0.18	1.69 0.22	12	NS
FEV1%	%	48 7	59 11	9	NS
FEFR75	L/S	0.65 0.12	0.71 0.9	5.9	NS
FEC	LIT	0.78 0.03	0.82 0.05	3	NS
FEC1	LIT	0.63 0.06	O.71 0.07	4.5	NS
FEC1%	%	81 7	86.5 11	7	NS

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