

Even a single breath counts

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Abstract

Study objective: To assess the correlation of single breath count and breath holding time with standard measures of pulmonary function testing, namely FEV1, FVC, FEV1/FVC ratio and PEF.

Materials and methods:

Design: Prospective observational study.

Setting: Institute of Thoracic Medicine, Chetpet, between January 2010 -May 2010.

Sample size: 200 cases, which included patients greater than 12 years of age, with symptoms and signs of obstructive airway disease referred to Pulmonary function testing lab for assessment.

Spirometry (Easy pro one, NDD) was done on all the study participants and the following variables were measured and recorded, FEV1, FVC, FEV1/FVC ratio and PEF. Then single breath count was done by asking the patient to take a deep breath and count as far as possible in their normal speaking voice without taking another breath. Counting was timed to a metronome set at 2 counts per second. Breath holding time was done by asking the patient to hold their breath after an effort inhalation till the breaking point. The time duration in seconds was measured and correlated with, FVC, FEV1/FVC ratio and PEF.

Conclusion: Single breath count and breath holding time correlated well with FEV1 and FVC. In resource poor settings SBC & BHT can be a reasonable alternative to spirometry.

Keywords: SBC-single breath count, BHT-breath holding time, FEV1-Forced expiratory volume in one second, FVC-Forced vital capacity.

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I. Introduction

After John Hutchison's invention of Spirometry, it has become a valuable test in the assessment of pulmonary function.¹ It measures the volume of air an individual inhales or exhales as a function of time.² It is performed to detect the presence or absence of lung disease, quantify lung impairment, monitor the effects of occupational/environmental exposures, preoperative evaluation and determine the effects of medications. Still sometimes patients' condition in the Emergency department, cost, non availability, calibration problems and lack of patient and technician motivation precludes its widespread usage. So any test which is simple, non invasive, safe, cost effective and widely available that can be used as an adjunct to Spirometry would be welcome. Single breath count and Breath holding time are simple tests used in the bed side assessment of pulmonary function.⁴ So we compared SBC and BHT with various spirometric indices in our Pulmonary function laboratory to know their level of correlation.

II. Materials And Methods

The study was approved by Institutional ethics committee. Both male and female patients, age greater than 12 years, with signs and symptoms of obstructive airway disease referred to pulmonary function laboratory, Institute of Thoracic medicine, Chetpet were selected as cases. Of the recruited study participants, patients who were able to complete Pulmonary function testing as per the ATS/ERS task force recommendations were included for analysis. So a total of 200 participants were selected. Non consenting individuals, patients with active pulmonary tuberculosis, Acute exacerbation of COPD, Acute severe asthma and haemoptysis were excluded from the study.

All the study participants were subjected to do spirometry by final year Pulmonary medicine resident and the following variables were recorded; FEV1, FVC, FEV1/FVC ratio, PEF. Single breath count is the measurement of how far an individual can count in a normal speaking voice after an effort inhalation. The count was in cadence to a metronome set at 2 beats per second. Then the patient was asked to do Breath holding

time.⁵The patient was asked to hold the breath after an effort inhalation till the breaking point. Both SBC and BHT was performed three times and the best of the 3 values was included for analysis. Comparisons were made using Spearman correlation coefficients between SBC & BHT and FEV1, FVC, FEV1/FVC ratio, PEF. All statistical calculations were conducted using SPSS version 20.0. The correlation coefficient were evaluated by Spearman's rho test. P value of less than 0.05 was considered to be significant as the distributions were normal.

III. Results

A total of 200 were enrolled, with age ranging from 13 to 71 years. The median age was 26 years, and 51.5% were male. People who were referred with symptoms and signs with obstructive airway disease for Pulmonary function assessment were the study participants. Total number of smokers in the study were 47. Number of people with reduction of FEV1/FVC ratio less than 70 was 36. Table 1 shows Spearman's correlation coefficient analysis. Single-breath counting showed fair correlation with FEV1 ($r = 0.426$) and with FVC ($r = 0.447$). There was good correlation between BHT and FEV1 ($r = 0.56$) as well as with FVC ($r = 0.552$). BHT showed a weak correlation ($r = 0.193$) with the FEV1/FVC ratio and PEF($r = 0.33$). SBC also showed weak correlation with PEF($r = 0.248$). All results were significant at the 95% confidence level. All enrolled subjects were able to understand the instructions and complete the study without difficulty. No subjects were excluded due to lack of cooperation or difficulty in performing SBC and BHT. Total time spent on instructions was only 30 seconds per patient. There were no dropouts or observed complications.

Table 1: Spearman's correlation coefficient analysis of SBC, BHT with FEV1, FVC, PEF, FEV1/FVC

Variables	SBC		BHT	
	R	P	R	P
FEV1	0.426(**)	0.0001	0.560(**)	0.0001
FVC	0.447(**)	0.0001	0.552(**)	0.0001
PEF	0.248(**)	0.0001	0.333(**)	0.0001
FEV1/FVC	0.068	0.339	0.193(**)	0.006

** - Correlation is significant at the 0.01 level.

* - Correlation is significant at the 0.05 level.

IV. Discussion

Earliest note on the significance of Breath holding test as a marker of cardiopulmonary function was made by Sarbarez of Bordeaux.⁶ He found the average normal voluntary apnoeic interval to be from 20-25 seconds in duration; while an interval of 30-35 seconds was exceptional.⁶ In his test he did not use preliminary forced inspiration. Deep inspiration or involuntary expiration lengthened the pause from 40 to 50 seconds. The amount of time a person can hold his breath is influenced by the pO₂, pCO₂ and lung volume.⁷ pO₂ of the gas breathed markedly influence the duration of breath holding and the rate of pulmonary diffusion of oxygen. Anxiety can reduce the duration of breath holding.⁷ So it is important to relax the subjects before performing the test. Yandell Henderson has given directions to perform breath holding test.⁶

1. Sit quiet for 5 minutes.
2. Take a full but not too deep breath
3. Hold it with mouth and nostrils closed
4. Note time in seconds.

There are a number of ways of assessing Pulmonary function in the bedside like cough test, wheeze test, maximum laryngeal height, Debono's Whistle test, Snider's match blowing test, watch and stethoscope test, Single breath count and Sarfarez Breath holding test.⁴

In our institution we routinely use Single breath count for pre operative pulmonary evaluation for patients who are not able to perform Spirometry. Bartfield et al in his study has correlated Single breath count with FEV1 and PEFR, and has concluded that Single breath count correlates better with FEV1 than with PEFR.⁴ We have correlated both Single breath count and Breath holding time with FVC, FEV1, PEFR & FEV1/FVC ratio. Our findings shows that Single-breath counting showed fair correlation with FEV1 ($r = 0.426$) and with FVC ($r = 0.447$). There was good correlation between BHT and FEV1 ($r = 0.56$) as well as with FVC ($r = 0.552$). BHT showed a weak correlation ($r = 0.193$) with the FEV1/FVC ratio. Both SBC and BHT showed weak correlation with PEF ($r = 0.248$) & ($r = 0.333$) respectively. This level of correlation of SBC and BHT with PEF is slightly low when compared with Bartfield et al. But correlation of SBC, BHT with FEV1 and FVC were good enough and is comparable with the results of Bartfield et al. Between SBC and BHT, the latter seems to correlate well with the spirometric indices. There are several advantages of Single breath count and breath holding time. Unlike spirometry there is no mouth piece, no concern about contamination of the equipment or transmission of contagious disease, no specialised breathing techniques.⁴ Recently single breath count has been

correlated with neck flexion and has been found to be useful tools for bedside assessment of respiratory function in patients with Myasthenia gravis.¹⁰ Single breath counting has also been used for measuring pulmonary function testing in children since it is easy to perform and has good correlation with standard measures of pulmonary function and shows promise for measuring asthma severity.^{8,9} Although there are some studies correlating single breath count with spirometric indices this is the only study which correlates both SBC and BHT with standard measures of pulmonary function.

V. Conclusion

It can be safely concluded that both SBC and BHT are good tools for assessing pulmonary function in the emergency and resource limited settings.

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