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ORIGINAL RESEARCH

Comparative Study on Sensitivity of PEF and FEV1/FVC in Diagnosis of Chronic Obstructive Pulmonary Disease (COPD) in Shohada Tajrish Hospital

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Abstract: **Introduction:** This paper aims to determine the effectiveness and sensitivity of peak expiratory flow in early diagnosis of chronic obstructive pulmonary disease (COPD). In view of high cost and unavailability of spirometry and the ever-increasing prevalence of COPD as a result of cigarette smoking, this study can do much to lighten the economic burden in national health system. **Materials and Methods:** We examined 250 patients taking spirometry test in Shohadaye Tajrish Hospital during 2008, chosen by simple random sampling method. COPD was defined as FEV/FVC<70% according to existing resources. PEF values smaller than 80% were considered as abnormal based on ATS criteria. We assessed PEF sensitivity in comparison with FEV1/FVC. **Results:** COPD prevalence among spirometry tests was 21.2%. Out of the patients, 76.27% were male and 92.9% were older than 40. PEF sensitivity was 74% and its specificity was 97.5%. **Discussion:** The higher COPD prevalence among men may be explained by higher cigarette smoking rate among men than in women in our country. Moreover, COPD occurrence risk increases with age. **Conclusion**: The positive predictive value of PEF compared with EFV1/FVC reveals that this test is an appropriate diagnostic tool which can diagnose COPD earlier than EFV1/FVC.

Keywords: COPD; FEV1; FEV1/FVC; PEF

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1. Introduction

With great advances in different scientific areas, medical society is increasingly paying attention to the quality of life (1). COPD is a major debilitating disease defined as irreparable obstruction of air flow (2). COPD prevalence is estimated to be 10.1% for stage ⊓ and above (11.8% in men and 8.5% in women) and varies from one country to another. Studies report the prevalence to be 17% in USA, 9.9% in UK, 10.1% in Denmark, 8% in Sweden, 7.6% in India and 14.3% in Spain (3). The prevalence also increases with age (2). This number will rise if spirometry is used rather than relying on clinical examination. If we accept GOLD criteria in spirometry interpretation, COPD prevalence in UK reaches to 18% in general and 29% in people above 46 (4). We should also bear in mind that only 18.6% of these people are identified (5). The ever-increasing prevalence of this disease makes it imperative to conduct a study on early diagnosis and treatment of COPD(6).

COPD causes activity limitation for 14 million days per year and causes disability for 50 million days per year. It is the only cause of mortality to be on the rise, with 22% increase over the recent two decades (7, 8). The number of patients with COPD has doubled during the past 25 years and the 10-year post-diagnosis fatality rate is over 50% (9, 10). The most important risk factor associated with COPD is cigarette smoking, with nearly half of middle-aged male smokers having abnormal spirometry. Fatality rate of smokers is 10 times that of non-smokers (5, 11).

Spirometry is the best COPD diagnostic tool, but it is expensive, unavailable and hard-to-use. Such disadvantages have discouraged the early treatment of the disease and made it essential to find a practical, easy-to-use, and cheap diagnostic tool (11).

Peak flow meter was first introduced in 1959 as a portable

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tool for examining lung function in emergency conditions. It is a simple and repeatable device which shows the amount of air flow obstruction. PEF is the highest air value in a deep exhalation. Precise measurement requires an accurate inhalation followed by a deep exhalation (12, 13).

This value can be measured by spirometer or peak flow meter. PEF is used to assess the strength of air ways, person's effort, neuromuscular health and elasticity. Since the reliability of data produced by this device is highly associated with patient's effort, the best solution for obtaining a precise number is to inform the patient about the proper technique (13, 14).

A major application of peak flow meter is the management of asthma. Where spirometry is not diagnostic for a patient with asthma symptoms, this device is the best tool for diagnosing COPD and distinguishing it from asthma(13, 15) .

PEF is minimal in morning and maximal in evening. 20% difference between morning and evening values is diagnostic for asthma. A major application of PEF is the diagnosis and treatment of exacerbation asthma. 50≤PEF≤80% indicates risk and tells the patient to see a doctor and increase the number of bronchodilators (14, 16). 50 %< PEF indicates exacerbation. A random study on asthmatic patients reports 16% increase in FEV1 after the lapse of 18 months (17, 18).

While some researchers have analyzed the role of PEF in early diagnosis and treatment of COPD, there is no consensus on the application of PEF. The materials available in guideline continue to emphasize the use of FEV1 as a diagnostic tool (19, 20). Some research has suggested that COPD diagnosis with mere clinical examination is infeasible and final diagnosis requires further examinations such as PFT. Moreover, while spirometry produces precise data, general practitioners are more familiar with PEF and find it difficult to use spirometry (13).

On the other hand, since PFT drop in people with COPD occurs slowly, annual or biennial execution does not produce sufficient information. So, it is necessary to use another tool for assessing COPD acute attack (21).

It could be said, therefore, that spirometry is not appropriate for patient screening as it is hard-to-access and time-consuming. Some research has suggested that social protection entails the supervision of all smokers in the society. As this is impossible, we have to focus on heavy smokers and old people. Obviously, PEF is a suitable tool for assessing this big group of the society thanks to its availability, low price and reliability.

Given the above facts, it is essential to conduct a study on PEF sensitivity in comparison with FEV1 in the diagnosis and treatment of COPD.

2. Materials and Methods

This is an observational and analytical study performed during a limited period. Samples were selected by simple random sampling method from among spirometry tests performed for one year (April 2008 through March 2009) in Shohada Tajrish Hospital. We examined 250 patients based on $n=z^2(1-a)pq/d^2$,with a-5% and prevalence of 18% in spirometry (FEV1/FVC<70%). All patients took similar spirometry tests and unreliable samples with non-standard flow-volume curve were excluded from study.

Age and gender distribution of samples was determined and then the data was statistically analyzed. Based on the existing resources, standard definition was set on FEV1/FVC<70% and the patients were divided into three groups of light, average and heavy according to severity of disease. PEF<80% was set as a sign of obstruction. We assessed the amount of sensitivity and specificity in comparison with FEV1/FVC in the diagnosis of obstruction.

3. Results

We examined 250 randomly selected spirometry tests performed during 2008 in Shohada Tajrish Hospital and obtained a prevalence of 21.2%. 67.5% of the candidates were male, 41.8% were below the age of 40, 33.8% were between 40 and 60, 24.3% were above 60. Out of the patients with obstructive disease, 76.27% were male and 92.9% were above the age of 45. (Figure1)

Obstructive disease was confirmed in 48.9% of patients who were older than 65. This number was 17.5% for the age of 65 and below. (Figure2)

Out of the patients with obstructive disease, 8% had mild obstruction, 35.4% had moderate obstruction, and 56.5% had severe obstruction.

We compared PEF with FEV1/FVC in the diagnosis of COPD based on ATS criteria and ROC and obtained the following results. Since other resources have confirmed FEV1/FVC as COPD diagnosis standard, we calculated PEF sensitivity in the diagnosis of COPD based on these resources. (Table1)

On the other hand, since FEV1 / FVC is accepted as the airway obstruction detection standard in other sources, we calculated the PEF sensitivity for COPD diagnosis based on these sources. (Table 2)

4. Discussion

Do we know any test which can show air flow obstruction in shortest time? The debate on the use of spirometry for the above purpose remains open and physicians often decide based on their own experiences.

In 1988 Kelly Gibson describe in their article that Spirometry has more sensitivity than PEF in COPD also they showed

strength correlation between FEV1 and PEF (22).
However other article shows strength correlation between FEV1 and PEF (r=0.95) but none of them showed that FEV1 is superior to PEF. It seems that in same sensitivity PEF is superior to FEV1 because of cheapness and feasibility (23). in a cross-sectional study by national health and nutritional estimated survey (NHANES) in COPD patients according to FEV1/FVC<70% and FEV1<80% and PEF<80 % as standard criteria PEF sensitivity for overall COPD case was 90% and for moderate to severe case has 100% sensitivity and 80% specificity (24). Dr. White article despite superiority of FEV1 mention that PEF validity and even reproducibility is more than FEV1(25).
COPD despite other chronic disease lick, DM, HTN, IHD has two phases stable and unstable or exacerbation, treatment of exacerbation has much more benefit and PEF can find the case of COPD exacerbation so is a good tool for diagnosis and treatment in this stage (26, 27).
COPD prevalence percentage obtained by this study is in line with previous statistics. The prevalence is higher in men than in women, which may be explained by higher cigarette smoking rate among men in our country. If we define obstruction as FEV1/FVC<70% according to reputable resources, the results reveal a sensitivity of 74% and positive predictive value of 98%. PEF reduction before drop in FEV1/FVC is indicative of obstruction. In other words, PEF drops at the time of reduction in the above ratio, but the contrary is very unlikely (false negative smaller than 2%). Moreover, the negative predictive value indicates that if PEF does not drop, air flow obstruction can be rejected with high confidence. This is also supported by the validity of 81.2%.

5. Conclusion

The results obtained by this study suggest that PEF reduction may be an early indication of air flow obstruction. Although different resources continue to emphasize that FEV1/FVC ratio is diagnostic of COPD, peak flow meter is a cheap and easy-to-access tool with high sensitivity which can play an important role in COPD diagnosis. Furthermore, given the high negative predictive value obtained for this test, it can dispense with complicated and expensive diagnostic tests such as spirometry and lighten the economic burden in national health system.

6. Appendix

6.1. Acknowledgements

None.

6.2. Author contribution

All the authors have the same contribution.

6.3. Funding/Support

None.

6.4. Conflict of interest

No conflict of interest.

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Table 1: PEF comparing with gold standard 80%.

	PEF≥80%	PEF<80%
FEV1/FVC≥80%	91	8
FEV1/FVC<80%	29	122

Sensitivity: 80.7%
Specificity: 91.9%
Positive predictive value: 93.8%
Negative predictive value: 75.8%

Table 2: PEF comparing with gold standard 70%.

	PEF≥80%	PEF<80%
FEV1/FVC≥70%	75	2
FEV1/FVC<70%	45	128

Sensitivity: 74%
Specificity: 97.5%
Positive predictive value: 98%
Negative predictive value: 62.5%
Validity: 81.2%

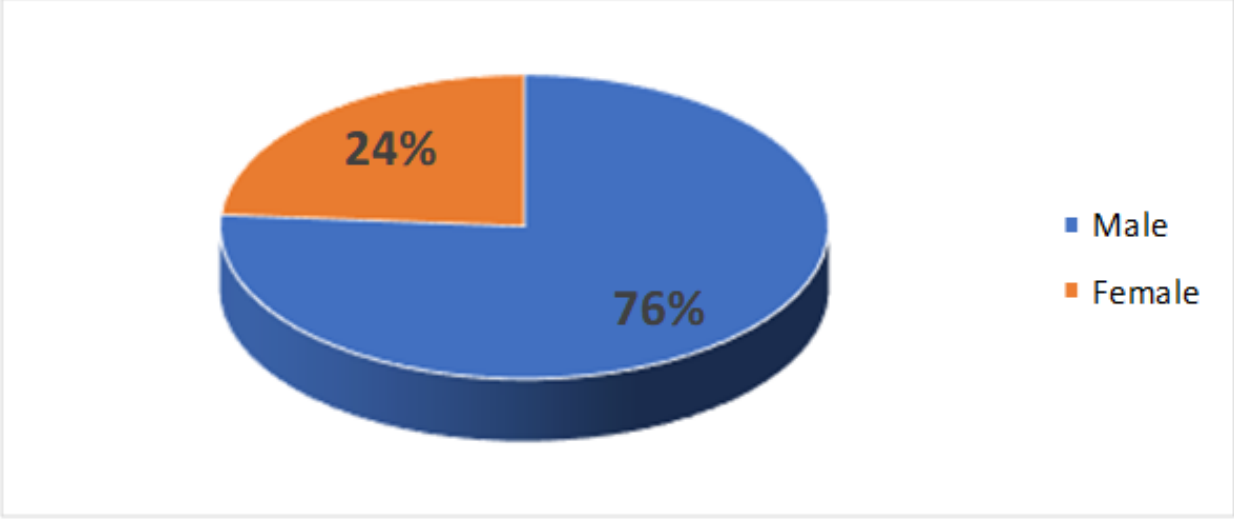

Figure 1: Distribution of obstruction percentage according to patient sex.

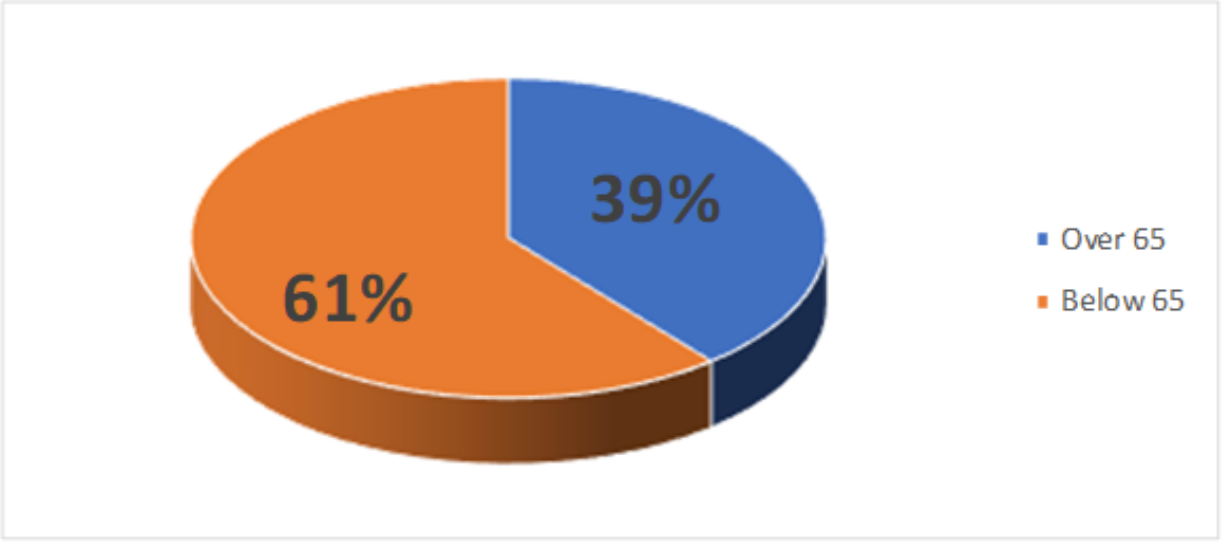

Figure 2: Distribution of obstruction percentage according to patient age.