Variability In The Interpretation Of Pulmonary Function Tests

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Abstract

Pulmonary function tests (PFTs) interpretations can vary among pulmonologists although several guidelines are available to facilitate interpretation of the raw data. We designed a study to determine the degree of agreement in the interpretation of PFTs. This study was a survey by mail. Five PFTs with a variety of obstructive and restrictive defects were mailed with an interpretation form and a demographic questionnaire to 208 Board Certified pulmonologists. Ninety-five physicians responded to the survey, 85% had more than 5 years experience, 57% physicians practiced in a university or an academically affiliated hospital and 41% taught PFT interpretation. There was about 90% agreement in PFT interpretation in case of severe obstruction and restriction. The degree of agreement among pulmonologists was much lower in cases of milder and mixed disorders. Except for a severe obstructive and restrictive defect, we conclude that there is significant variability in PFT interpretation by experienced pulmonologists.

ABBREVIATION

ACCP: American College of Chest Physicians;
ATS: American Thoracic Society;
BC: Board certified;
DLCO: Diffusion capacity for carbon monoxide;
PFTs: Pulmonary Function Tests.

INTRODUCTION

Pulmonary function tests (PFTs) guide physicians in making diagnostic and therapeutic decisions. Several guidelines are available to facilitate interpretation of the raw data; yet, interpretations vary among pulmonologists.[1, 8, 9, 12] A great deal of disagreement is present in the narrative interpretation of the same raw data.[9, 12] The reasons for these differences are not entirely clear, but may include training bias, differences in the knowledge of pulmonary physiology or training, the use of different guidelines or normal ranges. We designed a study to determine the degree of agreement in the interpretation of pulmonary function tests by pulmonologists.

We conducted a survey by mail of PFT interpretations by board certified pulmonologists in the state of Illinois. Five PFTs with a variety of obstructive and restrictive defects were mailed with an interpretation form and a demographic questionnaire to 208 pulmonologists. The intent of the PFT interpretation was to determine the homogeneity of responses, and not the frequency of a “correct” answer.

METHODS

This study was a survey by mail of board-certified pulmonologists who belonged to the Illinois chapter of the American College of Chest Physicians (ACCP) asking for formal PFT interpretation. The survey questionnaires included an interpretation form and a demographic questionnaire, which were mailed to 208 pulmonologists. The demographic information included type of hospital, years in practice, time spent in pulmonary medicine, the number of PFT's interpreted in a month and whether respondents taught PFT interpretation. The PFT interpretation questionnaires were designed to assess variation in the interpretation of pulmonary function test data. The questionnaires included a form for assessment of lung volumes, airflow rates, pulmonary diffusion capacity for carbon monoxide (DLCO), bronchodilator responses and overall interpretation of PFT as normal, obstructed, restricted or mixed. The interpretation responses were analyzed by comparing the interpretation from each pulmonologist to other interpretations for the same pulmonary function test. A second survey was mailed 8 weeks later to those who had failed to respond. The distribution for each variable was determined by a percentage in each category.

RESULTS

A total of ninety-five physicians responded to either of the two mailings. Seventy three percent were between ages 36 and 50, 85% had been practicing for more than 5 years. Forty-three percent practiced in a community hospital, 39% in an academically affiliated hospital and 18% in a university. Fifty-five percent were in practice for more than 10 years and 58% interpreted more than 30 PFTs a month. Fifty-one percent taught PFT interpretation. Fifty percent used current American Thoracic Society (ATS) criteria. The figures 1 to 5 summarize the results of the study presented as each PFT with an individual table representing the response to the interpretations of these PFT's by pulmonologists. Our data shows percentage of agreement among pulmonologists in various PFT parameters such as forced vital capacity (FVC), forced expiratory volume in 1 second (FEV1), FEV1/FVC ratio, maximum voluntary ventilation (MVV), total lung capacity (TLC), functional residual capacity (FRC), residual volume (RV), DLCO, response to bronchodilator; and the final interpretation of the PFT as normal, obstruction, restriction or mixed. PFT 1 showed >90% agreement in most of the parameters except for TLC and bronchodilator response. PFT 2 showed >90% agreement in FVC, FEV1, TLC, MVV, RV and in the bronchodilator response, however, significant variability was observed the assessment of FEV1/FVC ratio, FRC, DLCO and in the final interpretation of this PFT. PFT 3 showed ≥90% agreement in most of the parameters except for FEV1/FVC ratio and DLCO. PFT 4 showed >90% agreement in most of the parameters except for FEV1/FVC ratio, TLC, FRC and in the interpretation of PFT. PFT 4 showed >90% agreement in most of the parameters except for the bronchodilator response and in the interpretation of PFT. There was >90% agreement in the final interpretation of PFT in case of severe obstruction and restriction as shown in Figure 1 and 3, however, marked variability was observed in the interpretation of PFTs shown in Figure 2, 4 and 5. These findings suggest that, with the exception of severe obstructive and restrictive defect, significant variability may occur in the interpretation of PFTs by the pulmonologists.

Figures 1 to 5: The figures 1 to 5 show individual PFTs 1 to 5 with their respectively interpretation results tabulated as percentage of agreement among the pulmonologists in various PFT parameters such as forced vital capacity (FVC), forced expiratory volume in 1 second (FEV1), FEV1/FVC ratio, maximum voluntary ventilation (MVV), total lung capacity (TLC), functional residual capacity (FRC), residual volume (RV), DLCO, response to bronchodilator; and the interpretation of the PFT as normal, obstruction, restriction or mixed.

Figure 1

Figure 1a, b: PFT 1 shows >90% agreement in most of the parameters except for TLC and bronchodilator response.

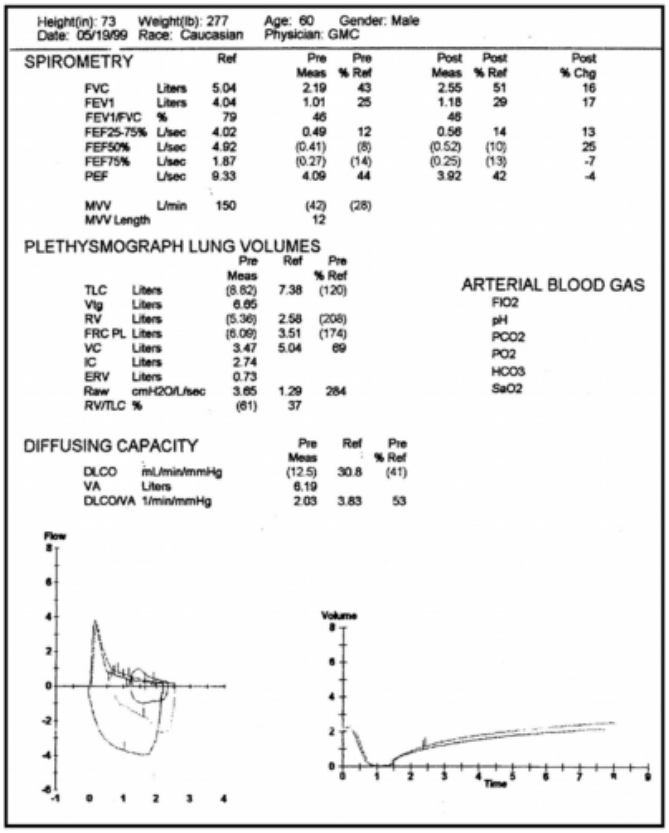

Figure 2

PFT 1	Normal (%)	Increase (%)	Decrease (%)
FVC	0	0	100
FEV1	0	0	100
FEV1/FVC	0	0	100
MVV	5	0	95
TLC	22	77	1
FRC	0	100	0
RV	1	99	0
DLCO	0	0	100

Bronchodilator	Yes	No
Response	86	14

Interpretation

Normal	0 %
Obstruction	99 %
Restriction	0 %
Mixed	1 %

Figure 3

Figure 2a, b: PFT 2 shows >90% agreement in FVC, FEV1, TLC, MVV and bronchodilator response, however, significant variability was observed the assessment of FEV1/FVC ratio, FRC, DLCO and in the final interpretation of this PFT.

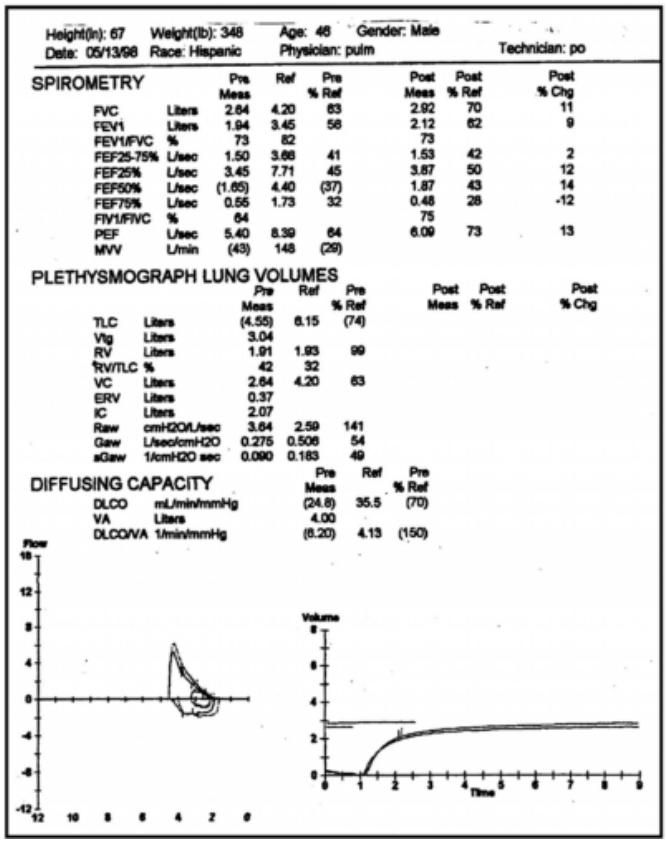

Figure 4

PFT 2	Normal (%)	Increase (%)	Decrease (%)
FVC	0	1	99
FEV1	0	1	99
FEV1/FVC	49	8	43
MVV	1	0	99
TLC	1	0	99
FRC	34	3	63
RV	95	4	2
DLCO	17	73	10

Bronchodilator	Yes	No
Response	5	95

Interpretation

Normal	0 %
Obstruction	1 %
Restriction	52 %
Mixed	47 %

Figure 5

Figure 3a, b: PFT 3 shows ≥90% agreement in most of the parameters except for FEV1/FVC ratio and DLCO.

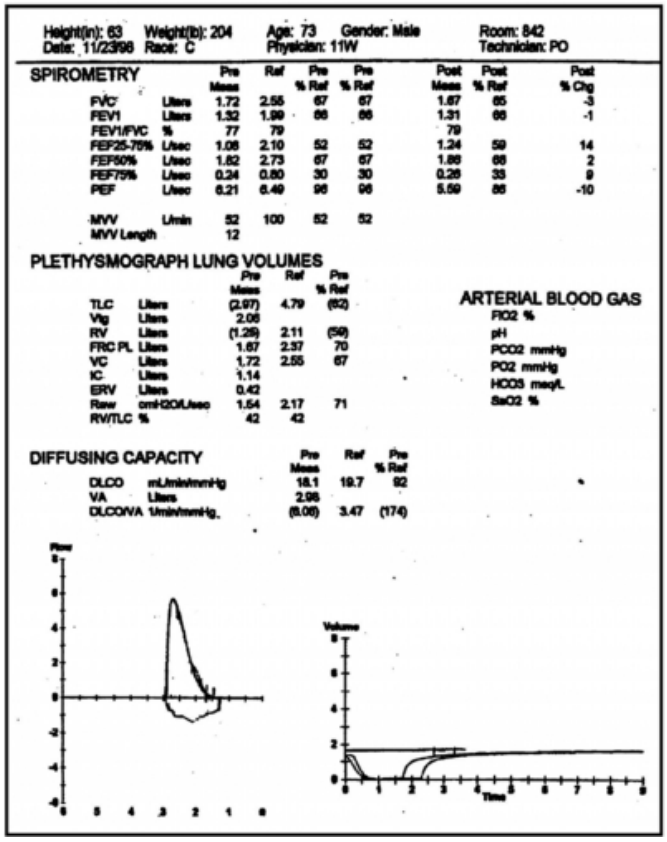

Figure 6

PFT 3	Normal (%)	Increase (%)	Decrease (%)
FVC	0	0	100
FEV1	1	0	99
FEV1/FVC	85	2	13
MVV	5	1	94
TLC	0	0	100
FRC	2	0	98
RV	2	0	98
DLCO	18	82	0

Bronchodilator	Yes	No
Response	0	100

Interpretation

Normal	0 %
Obstruction	0 %
Restriction	90 %
Mixed	10 %

Figure 7

Figure 4a, b:PFT 4 shows >90% agreement in most of the parameters except for FEV1/FVC ratio, TLC, FRC and in the interpretation of PFT.

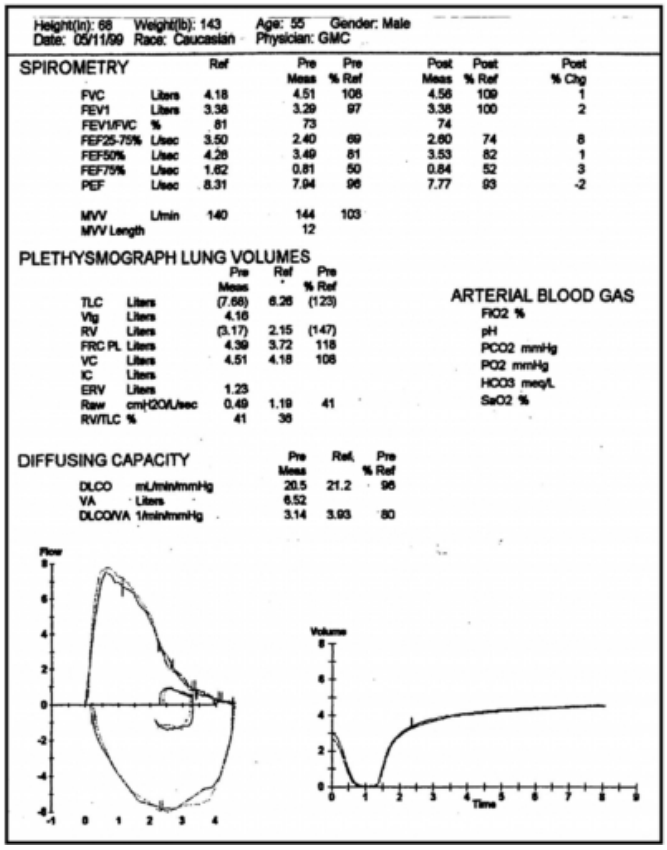

Figure 8

PFT 4	Normal (%)	Increase (%)	Decrease (%)
FVC	99	1	0
FEV1	100	0	0
FEV1/FVC	46	0	54
MVV	100	0	0
TLC	19	81	0
FRC	77	22	1
RV	8	92	0
DLCO	97	0	3

Bronchodilator	Yes	No
Response	0	100

Interpretation

Normal	47 %
Obstruction	53 %
Restriction	0 %
Mixed	0 %

Figure 9

Figure 5a, b: PFT 4 shows >90% agreement in most of the parameters except for the bronchodilator response and in the final interpretation of PFT.

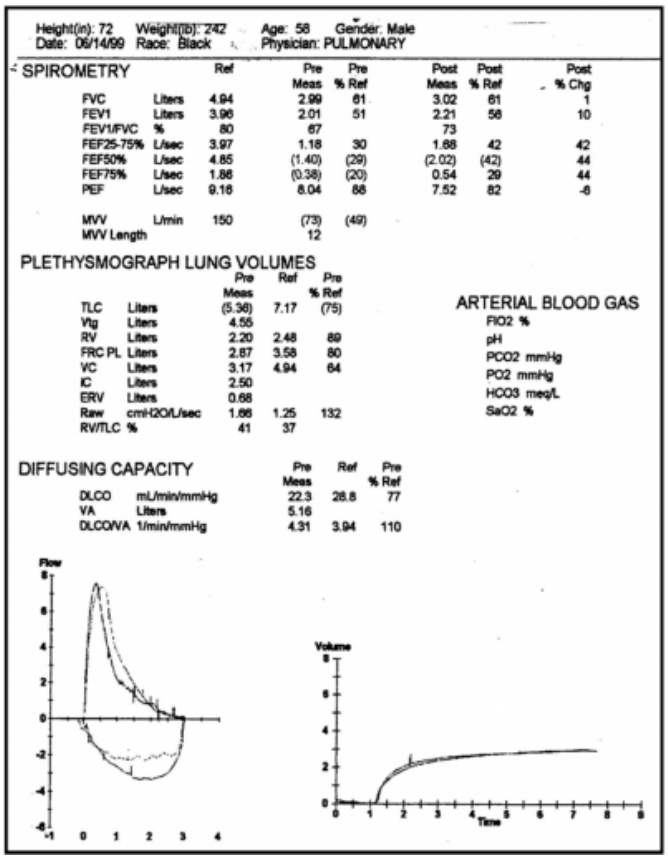

Figure 10

PFT 5	Normal (%)	Increase (%)	Decrease (%)
FVC	0	0	100
FEV1	0	0	100
FEV1/FVC	3	0	97
MVV	4	0	96
TLC	7	0	93
FRC	92	0	8
RV	96	1	3
DLCO	94	0	6

Bronchodilator	Yes	No
Response	28	72

Interpretation

Normal	0 %
Obstruction	20 %
Restriction	0 %
Mixed	80 %

DISCUSSION

Pulmonary function testing plays an essential role in making diagnostic and therapeutic decisions.[1, 8] The clinical value of lung function tests is maximized when good quality tests are interpreted with appropriate reference values and appropriate interpretive schemes.[1, 5] Over the years considerable measures have been taken to reduce the technical and biologic variation in the pulmonary function testing. Standardizing requirements for instrument performance and protocols for testing have significantly reduced intra-instrument and inter-instrument variability.[11, 16] Also increased accountability for the effects of diurnal, circadian, and seasonal changes in the measurements has reduced intra-subject or biologic variability in pulmonary function testing.[1, 7, 11, 12] However, a great deal of disagreement exists in the narrative interpretation of PFT data. There are several guidelines available to facilitate the interpretation of the raw data, such as American Thoracic Society, Intermountain Thoracic Society, European Thoracic Society, Computer-assisted interpretation and others.[1,2,3,4, 14] Many clinicians also use their personal and training experience as well as the textbook information to assist PFT interpretation. However, despite the interpretation guidelines, significant variability has been observed in the interpretations of these tests among physicians.[1,2,3,4,5,6] In this study, we demonstrate that, amongst experienced pulmonologists, with the exception of severe obstructive or restrictive defect, significant variability exists in the interpretation of lung function tests. Our group included experienced pulmonologists, 85% of them have been in practice for more than 5 years and 58% reported reading more than 30 PFTs a month. We had an equal distribution of pulmonologists practicing in a university or university affiliated hospital or in private practice settings; and 50% of them taught PFT interpretations. However, only 50% used present ATS criteria, and despite use of these criteria showed considerable variability in their PFT interpretation. Reasons for the differences in PFT interpretation are not entirely clear, but may include training bias, differences in knowledge of pulmonary physiology, the use of different guidelines or normal ranges, or addition of subjective analysis. In conclusion, we demonstrate that, except for severe obstruction and restriction there is significant variability in PFT interpretation by experienced pulmonologists. This variability may have important diagnostic and therapeutic implications for patient care and suggest that training and standardization is necessary.

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