Impact of Spirometry on the Management of Chronic Obstructive Airway Disease

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A simple spirometer was tested in an outpatient family practice to determine whether its use increased detection of chronic obstructive airway disease (COAD) in patients at risk, more accurately identified patients with reversible bronchospasm, and helped to make the most of their bronchodilator therapy. Three (17 percent) of 18 patients at risk, previously unlabeled, were found to have COAD. Of 28 patients with a previous COAD diagnosis, 5 (18 percent) had the diagnosis deleted, and 5 who had previously been classified as "reversible" were reclassified as having "irreversible" bronchospasm ($P < .025$). Of 46 patients studied, bronchodilator therapy was changed in 18 (39 percent); 12 of these improved symptomatically according to a subjective score ($P < .02$). A few patients demonstrated a significant improvement in 1-second forced expiratory volume.

Chronic obstructive airway disease (COAD), also often referred to as chronic obstructive pulmonary disease, chronic nonspecific lung disease, and chronic airway obstruction, constitutes a spectrum of clinical diseases that includes the triad of asthma, chronic bronchitis, and emphysema.[1]

COAD is a major health problem, ranking second only to coronary disease as a cause of disability in persons over the age of 40 years.[2] The economic impact of COAD is great. A national survey of ambulatory medical care showed that during the 1973-74 year over 15.6 million patient visits (2.4 percent of all visits to office-based physicians) were for the problems of bronchitis, emphysema, and asthma.[3]

The diseases classified as COAD have overlapping clinical features. As a result, the terms are often confused in the literature and are frequently misused by physicians in daily clinical practice. Because these diseases often coexist, diagnostic differentiation becomes difficult.

Simple spirometry is useful in detecting COAD, classifying patients with COAD as reversible or irreversible based on their response to bronchodilators, and monitoring the course of the disease and adjusting therapeutic regimens.[4] Patients with

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reversible COAD have previously been shown to have significant objective as well as subjective functional improvement when treated vigorously for their disease.[5]

The purpose of this study was to determine whether the use of the simple spirometer in the ambulatory care setting enhances outpatient management of patients with COAD by increasing the rate of identification of patients with COAD in a population at risk, more accurately determining which patients have a reversible component of bronchospasm, and helping the physician to make the most of bronchodilator therapy, thus improving patients' short-term outcomes symptomatically and objectively as measured by improvement in pulmonary function tests.

Methods

This study was conducted with patients from the Wilkes Family Health Center, North Wilkesboro, North Carolina. Staffed by three young residency-trained family physicians, this practice serves a rural county of 60,000 people. Spirometry had not previously been available in the practice, and most COAD diagnoses had previously been made on clinical grounds. During the entry period all patients over 18 years of age visiting the practice were asked to participate in the study if (1) the patient was at high risk for COAD, or (2) the patient had previously been assigned a diagnostic label of any of the diseases in the COAD spectrum.

High-risk patients were defined as those with a 20 pack-year or greater smoking history recorded on the problem list in the patient's chart. Labels accepted as indicating a previous diagnosis of COAD were "chronic obstructive pulmonary disease," "chronic obstructive lung disease," "chronic obstructive airway disease," "asthma," "chronic bronchitis," or "emphysema."

Patients with previous COAD diagnoses were further classified as reversible or irreversible based on the diagnosis on the problem list and on current therapy being used. If the diagnostic label "asthma" was on the problem list or if the patient was using any kind of bronchodilator, the patient was classified as reversible. All other patients with a COAD history were classified as irreversible.

Patients entering the study underwent a standard initial evaluation including completion of the National Heart Lung Institute (NHLI) Respiratory Questionnaire,[6] and spirometric measurement of forced vital capacity (FVC), 1-second forced expiratory volume (FEV_1), and forced expiratory flow at 25 to 75 percent (FEF_{25-75}) on a Breon Model 2400 Spirometer. This simple, pneumatic, direct-recording spirometer previously has been shown to be accurate when compared with a water-sealed, 13.5-liter water-filled spirometer.[7]

Patient measurements were compared with standard nomograms established by Morris et al,[8] and the percentage of the patient's predicted measurement was calculated. A patient whose FEV_1 was less than 75 percent of his predicted FEV_1 or whose FEF_{25-75} was less than 55 percent of his predicted FEF_{25-75} was classified as having obstructive airway disease.[9] Patients demonstrating obstructive defects were then treated with aerosolized isoproterenol by inhaler and immediately retested. A 15 percent or greater improvement in FEV_1 was considered to be a good predictor of reversible disease.[10,11] Each spirometric test included three forced expirations with the patient's maximum effort. The best of the three values was used as the measured value for the study. The patient's physician was given the results of spirometric testing and allowed to use the results in planning further therapeutic intervention.

Patients were asked to return for repeat testing eight weeks after the initial measurements. At that visit patients were given a four-question subset of the NHLI Respiratory Questionnaire,* and they again underwent spirometry. As before, 15 percent or greater improvement in FEV_1 as compared with the study entry measurement was considered evidence of reversible disease. Patients were reclassified on the basis of the final spirometric results according to the presence and reversibility of COAD.

Comparison was made of prestudy and post-

*Questions used on final test were as follows: "During the last four weeks, has your breathing sounded wheezy and whistling?" "Have you had attacks of shortness of breath with wheezing?" "Have you been troubled with shortness of breath when hurrying on level ground or walking up a slight hill?" "Have you gotten short of breath walking with people your own age on level ground?"

Table 1. Patient Demographics and Characteristics Before and After the Study (N = 46)

Demographics		
Mean age (range)	56 (34-78) yr	
Sex		
Male	28 (61%)	
Female	18 (39%)	
Mean smoking history (range)	32.7 (0-96) pack-yr	
Other Characteristics	Pre-Study No. (%)	Post-Study No. (%)
Smoking Status		
Nonsmoker	14 (30)	15 (33)
Smoker	32 (70)	31 (67)
Diagnosis		
COAD	28 (61)	26 (07)
Reversible	22	17
Irreversible	6	9
No COAD	18 (39)	20 (43)
Treatment Status		
No bronchodilators	26 (57)	26 (57)
Bronchodilators	20 (43)	20 (43)

study data on cigarette consumption, diagnosis, bronchodilator status, subjective symptoms score, and pulmonary function as measured by FEV_1. The chi-square test was used to determine whether differences were statistically significant.

Results

Fifty-three patients entered the study between January 9, 1981, and March 18, 1981. Six patients could not be retested because of progressive illness; one did not comply with prescribed treatment. The average interval between initial and final testing was 73.5 days (range 15 to 156 days).

Demographic and medical characteristics of the patient population are shown in Table 1. Sixty-one percent of 46 patients completing the study were male; 39 percent were female. The mean age of the patients was 56 years (range 34 to 78 years). Seventy percent of the patients studied were smokers, with an average smoking history of 32.66 pack-years (range 0 to 96 pack-years).

Before the study, 18 (56 percent) of 32 smokers at risk had no COAD diagnosis. By spirometry three (17 percent) of these were found to have COAD: one reversible and two irreversible.

Of the 28 patients with a COAD diagnosis before the study, 14 were smokers. Prior to the study 10 of these had been labeled reversible and 4 irreversible. Two patients, one with reversible COAD and one with irreversible COAD, had normal spirograms. Three patients originally labeled as reversible were found to have irreversible COAD. Of the 14 nonsmokers with a COAD diagnosis, 12 had originally been labeled reversible, and 2 irreversible COAD. Two from the reversible group and one from the irreversible group had normal

Table 2. Diagnostic Labeling Errors Uncovered With Spirometry (N = 46)

Patient Group	Patients with Undiagnosed COAD	Patients with Overdiagnosed COAD	Patients with Mislabeled COAD (reversible-irreversible)	Total
Smokers	3	2	3	8
Nonsmokers (previous COAD label)	—	3	2	5
Totals	3	5	5	13

Table 3. Change in Subjective Score vs Other Parameters

	Change in Subjective Score		
	Increase	No change or decrease	P Value
Change in cigarette consumption			
Decrease	4	6	NS
Increase	17	19	
Change in bronchodilators			
Change	12	6	< .02
No change	9	19	
Change in FEV_1			
> 15 percent increase	2	5	NS
< 15 percent increase	19	20	

spirograms. Two patients originally labeled reversible COAD were relabeled irreversible COAD.

Of the 28 patients originally labeled as having COAD, the diagnosis was deleted in five (18 percent); 5 patients originally labeled reversible were relabeled irreversible COAD. Table 2 summarizes the diagnostic labeling errors uncovered in the study. Thirteen (28 percent) of the 46 patients studied had a change in diagnostic label.

Out of a possible four-point change in subjective score on the NHLI Respiratory Questionnaire subset (scale 0 to 4), 21 patients had no subjective score change between the initial and follow-up visit; 21 improved, and 4 had a lower score. The mean change in subjective score for the total population was +0.5 points.

Correlation was sought between improvement in subjective score and (1) decrease in cigarette consumption, (2) change in bronchodilator therapy, and (3) improvement in FEV_1 (Table 3). Statistically significant correlation was found between improvement in subjective score and change in bronchodilator therapy ($P < .02$, Spearman correlation coefficient = .35).

FEV_1 at the follow-up visit was compared with

FEV_1 at the initial visit. Twenty patients (44 percent) showed no increase in FEV_1; 19 patients showed an increase of less than 15 percent. Seven patients (15 percent) improved their FEV_1 by more than 15 percent.

No statistically significant correlations were found between change in FEV_1 during the study period and (1) decrease in cigarette consumption, (2) initial change in FEV_1 following inhaled isoproterenol, (3) change in bronchodilator therapy, or (4) increase in patient subjective score.

Discussion

Use of a simple spirometer in an outpatient family practice setting, where spirometry had previously not been available, made a difference in the way that patients with a previous diagnosis of COAD or at risk of having COAD were labeled diagnostically. Thirteen (28 percent) of 46 patients studied received a different diagnostic label. Three (17 percent) of 18 smokers at risk but without previous diagnoses were found to have COAD, one of which was "reversible." Five (18 percent) of 28 patients with previous diagnoses of COAD were found to have normal pulmonary functions. Five patients originally felt to have "reversible" COAD were reclassified as "irreversible" ($P < .025$).

As a result of the information obtained from the spirometry studies, the therapeutic regimens were changed in 18 (37 percent) of the 46 patients studied. Bronchodilators were added to the regimens of 6 patients; they were stopped for 4 patients, increased for 5 patients, and changed for 3 patients.

Changes in bronchodilator therapy seemed to make patients feel better, as reflected by improvements in subjective scores ($P < .02$). Some of the patients in whom bronchodilators were changed had improvement in FEV_1, but the small number of patients in the study may have precluded statistical significance. While these subjective and objective improvements suggest improved short-term outcomes resulting from new information available to the physician from the spirometry studies, the current experimental design introduces the possibility of a halo effect. To establish a conclusive relationship between use of spirometry and improved subjective and objective functional outcomes in patients with or at risk for COAD will require a randomized controlled trial.

Simple spirometry in the outpatient setting shows promise as a tool in the management of patients with chronic obstructive airway disease. The results of this preliminary study need to be confirmed with a randomized controlled trial using a larger patient population.

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