Relationship Between Dyspnea, Peak Expiratory Flow Rate and Wheeze in Obstructive Lung Disease

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Abstract

The relationship between dyspnea and airway obstruction is complex, and it is unclear to what extent measures of each correlate in patients with obstructive lung disease (OLD). Thus, the correlation between subjective assessment of dyspnea (dyspnea score using modified Borg scale) and objective assessment of dyspnea (peak expiratory flow rate using Mini Wright Peak Flow Meter and wheeze score using stethoscope) before and after bronchodilator (1 mg of turbutaline sulphate) were studied in 115 patients (62 males, 53 females) with OLD attending the chest clinic of Royal Irrigation Hospital, Nonthaburi, Thailand. The mean age of these patients was 47.4 $\pm$ 16.4 years. Good correlations were found ($r = 0.37$ to 0.52; $p < 0.001$) but dyspnea scores were better correlated with wheeze scores than peak expiratory flow rates. The change in dyspnea scores after bronchodilator also correlated with the change in peak expiratory flow rates and the change in wheeze scores ($r = 0.22$; $p < 0.02$ and $r = 0.28$; $p < 0.005$ respectively). Analyzing a subgroup of 48 dyspneic patients (prebronchodilator dyspnea score of 2 or more) revealed the following reponse groups : those with either a bronchodilator or dyspnea response alone, both together, or neither. Twenty-three patients (47.92 per cent) responded both subjectively and objectively. One (2.08 per cent) had a bronchodilator response only. Twenty (41.66 per cent) had a dyspnea response only, while four (8.33 per cent) had neither measurable response. The present study suggests that the assessment of dyspnea by using dyspnea score is vital and may be specially helpful in a situation where the objective assessment cannot be performed. In some individuals the subjective assessment of response to bronchodilator may be at least as valuable as objective data.

In the past, chest physicians have relied on the objective measure of lung function to assess the severity and response to treatment in patients with obstructive lung disease (OLD). Nowadays, there has been increased interest in the use of subjective measures of dyspnea in the assessment of tolerance and bronchodilator efficacy in patients with chronic obstructive lung disease and bronchial asthma[1-6]. Theoretically, those patients with the most severe airway obstruction should be the most dyspneic. But from the clinical experience this is not always the case. Some patients with

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little obstructive dysfunction are very dyspneic, while others with severe OLD are minimally symptomatic. Thus, the relationship between dyspnea and airway obstruction is complex, and it is unclear to what extent measures of each correlate in patients with OLD. Many previous studies have investigated the correlation between dyspnea and lung function[2,4-6]. However, this has involved either a small number of patients or many have had a selection bias in that only subjects complaining of breathlessness were included. In one study, a large group of patients were investigated, but only the correlation between spirometric evaluation and dyspnea were performed[1]. The primary objective of this study is to evaluate the correlation between dyspnea measured by a modified Borg scale and peak expiratory flow rate measured by Mini Wright Peak Flow Meter and the secondary objective is to evaluate the coreclation between dyspnea and wheeze assessed by a chest physician in patients with OLD attending the chest clinic of a 300-bed general hospital. Because of the estimated large number of patients enrolled in this study, we were able to correlate the results obtained by Mini Wright Peak Flow Meter with measures of airway obstruction over a wide range of objective and subjective involvement in patients with OLD. In addition, those patients who were dyspneic initially, we were also able to determine the relative number who responded subjectively, objectively, or both, to bronchodilator administration.

MATERIAL AND METHOD

Out-patients with OLD, male and female ages ranging between 15 - 80 years, who were referred to the chest clinic, Royal Irrigation Hospital, Nonthaburi, Thailand between May 1993 and November 1995 were enrolled in this study. Exclusive criteria included those who were unable to perform forced expiratory maneuvers using Mini Wright Peak Flow Meter or who had taken inhaled bronchodilator within 1 hour of arrival in the clinic. Patients who had active lower respiratory tract infections and hemoptysis or suspected to have malignancy were also excluded. One hundred and sixty-six patients represented the initial study population screened. These included those with known bronchial asthma, COPD or other restrictive lung disease who were being assessed in follow-up as well as newly diagnosed cases. Other individuals were being evaluated for chronic cough and dyspnea.

0	Nothing al atll
1	Very slight
2	Slight
3	Moderate
4	Somewhat severe
5	Severe

Fig. 1. Dyspnea score using modified Borg scale.

Protocol : Each subject was asked to rest for 10 minutes after arrival in the chest clinic. The chest physician then detected wheeze in each patient by using a stethoscope. Wheeze score (WS) was recorded as follows : 0, no wheezing; 1, faint wheezing audible only through a stethoscope; 2, wheezing that was also audible during quiet breathing; 3, obvious wheezing and dyspnea; 4, respiratory distress and obvious use of accessory muscles[7]. Next they were instructed by the nurse to record the degree of dyspnea felt at that moment, and described as "shortness of breath" by making a mark on the vertical scale. This consisted of a modified Borg scale that ranged from 0 to 5 and included verbal description (Fig. 1). The numbers nearest the mark made by the subject was referred to as the Dyspnea score (DS). Finally the patient performed successive forced expiratory maneuvers using a Mini Wright Peak Flow Meter. Peak expiratory flow rates (PEFR) were calculated as described below. The patient then received two doses (1 mg) of terbutaline sulphates (Bricanyl, Astra, Sweden), delivered by breath actuated Turbuhaler. Fifteen minutes later, wheeze score, dyspnea score and peak expiratory flow rate were repeated in identical techniques.

Three to five forced expiratory maneuvers were obtained before and after admininstration of the bronchodilator. The "best test" was defined as that which produced the largest number and which was reproducible to within 10 per cent on at least two determinations.

Predicted normal peak expiratory flow rates were those of Gregg I et al[8]. Obstructive lung disease was said to be present when prebronchodilator PEFR was 70 per cent or less of the predicted.

A bronchodilator response was defined as an improvement in PEFR of at least 15 per cent

after turbutaline sulphate. A dyspnea and wheeze response were defined as a reduction in DS and WS by at least one full category after bronchodilator.

For the purpose of the present study, no effort was made to distinguish between those individuals with asthma as opposed to COPD, and the term OLD is used to encompass both groups of patients.

Statistical Analysis

The degree of relationship between dyspnea score and all objective measurements were established by use of personal computer. Correlation coefficients were calculated for data before and after bronchodilator by using program EP1-6 INFO. The change in dyspnea score *vs* the change in peak expiratory flow rate or wheeze score were similarly examined. A p value of less than 0.05 was considered statistically significant.

RESULTS

One hundred and fifteen (62 males and 53 females) of 166 initially screened subjects conformed to the aforementioned definition of OLD and were included in the subsequent analysis. The mean age of these patients was 47.4 ± 16.4 years. The clinical data of 115 patients evaluated are shown in Table 1. The results of dyspnea score, wheeze score and peak expiratory flow rate with per cent predicted before and after administration of bronchodilator included per cent changes are seen in Table 2.

There was good correlation between DS and PEFR (Fig. 2) and between DS and WS before bronchodilator. However, DS was better correlated with WS ($r=0.43$; $p<0.001$) than PEFR ($r = -0.37$; $p<0.001$). Following turbutaline sulphate the mean percentage change in PEFR was 15.85, but there was considerable range of responses (0 per cent to 45.4 per cent) and the means DS and WS were 1.38, 1.06 and 0.57, 0.57 respectively before and after bronchodilator. Good correlation was also observed between DS and

Table 1. The clinical data of 115 patients.

Age	Sex		Total
	Male	Female	
15-20	3	4	7
21-40	10	20	30
41-60	26	25	51
61-80	23	4	27
Total	62	53	115

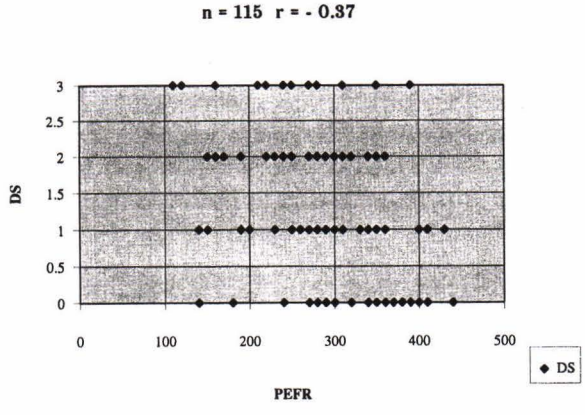

Fig. 2. Correlation between DS and prebronchodilator PEFR.

Table 2. Dyspnea score, wheeze score and peak expiratory flow rate (mean ± SD) before and after bronchodilator (n = 115).

	Before bronchodilator	After bronchodilator	Per cent change
1. DS	1.38 ± 0.95	0.57 ± 0.76	-
2. WS	1.06 ± 0.87	0.57 ± 0.71	-
3. PEFR	277.37 ± 75.67	320.09 ± 90.44	15.85 ± 12.02
(% predicted)	(53.51 ± 12.03)	(61.88 ± 14.77)	

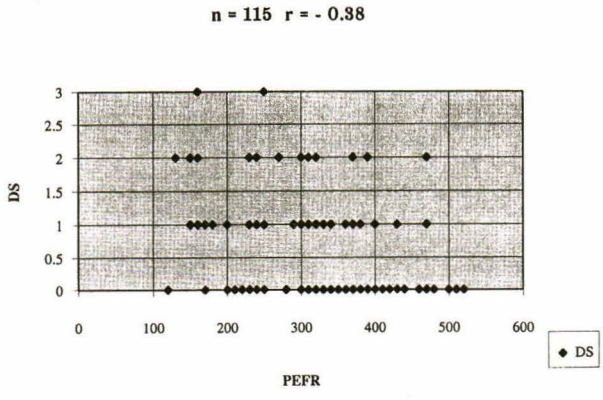

Fig. 3. Correlation between DS and post bronchodilator PEFR.

PEFR (Fig. 3) and between DS and WS post bronchodilator, but DS had a higher correlation with WS ($r=0.52$; $p<0.001$) than with PEFR ($r = -0.38$; $p<0.001$). There was fair correlation between change in DS and change in PEFR and between change in DS and change in WS after turbutaline sulphate ($r=0.22$; $p<0.02$ and 0.28; $p<0.005$ respectively).

Since some patients were not dyspneic before bronchodilator, they were incapable of reporting subjective improvement after turbutaline sulphate. Hence, a subgroup of 48 patients who were dyspneic at the time of testing as defined by a prebronchodilator DS of 2 or more was analyzed. Twenty - four (50 per cent) of 48 dyspneic patients responded to bronchodilator as measured by a change in PEFR fifteen per cent or more. Forty-three (89.58 per cent) showed a dyspnea response evidenced by a reduction in the DS by at least one category after bronchodilator. Thus, the overall response rate measured subjectively was nearly twice that measured objectively. Table 3 illustrates the number of patients who showed either a PEFR or dyspnea response alone, both together, or neither within the subgroup of 48 dyspneic individuals with OLD. By considering changes in dyspnea as well as improvement in PEFR as end points, four outcome groups were obtained. The most frequent pattern observed was improvement in both subjective and objective parameters (47.92 per cent). Only 8.33 per cent of individuals showed neither a significant PEFR nor dyspnea response.

DISCUSSION

In this study Mini Wright Peak Flow Meter, a small hand held device, was used to measure the degree of air flow obstruction and reversibility. This simple device is acceptable for its accuracy when compared with the standard Wright peak flow meter and stands up well to patient use[9]. The PEFR measured by either Wright peak flow meter or Mini Wright Peak Flow Meter corresponded well with FEV_1 measured by spirometer[10]. For the subjective assessment of dyspnea, a modified Borg scale that has been widely used to measure sensory perception at one specific point in time was selected[11]. Borg scale dyspnea index is an acceptable technique for measuring dyspnea as well as for recording change after bronchodilator[1,12]. To minimize bias in the assessment of WS, clinical examination in each patient was performed before recording of DS and PEFR.

Table 3. Bronchodilator and dyspnea responses in 48 dyspneic individuals with OLD.

	Bronchodilator response	No bronchodilator response	Total
Dyspnea response	23 (47.92%)	20 (41.66%)	43 (89.58%)
No dyspnea response	1 (2.08%)	4 (8.33%)	5 (10.41%)
Total	24 (50.00%)	24 (50.00%)	

A good correlation was found between dyspnea assessed by a modified Borg scale and PEFR measured by Mini Wright Peak Flow Meter in patients with OLD. These results support the findings of two previous studies[2,13]. Mahler and Wells concluded that clinical rating of dyspnea did correlate significantly with physiologic parameters of lung function. Their data revealed that the correlation between lung function and dyspnea for the less obstructed group of patients with asthma was very good and that for the more obstructed group with COPD was only fair[2]. Because most of the patients in this study were asthmatic with mild airway obstruction, the results of both studies therefore suggest good correlation between lung function or PEFR and dyspnea especially in mildly obstructed patients. However, their work differed from this study in that the Borg scale was not used to measure dyspnea. They used a previously validated baseline dyspnea index that is designed to score breathlessness by relying on the patient's history of recent functional impairment and activity - related dyspnea[5]. Burrow et al found that FEV_1, especially when expressed as a percentage of FVC, was the pulmonary function variable that best correlated with a history of dyspnea in patients with OLD but the relationship was not strong[13].

These results differ from the previous findings of McGavin et al and Wolkove et al[1,4]. McGavin showed a significant correlation between exercise performance, as measured by the 12-minute walk and FEV_1 as well as FVC, there was no significant correlation between either of these indices of airway obstruction and subjective assessment of dyspnea. Wolkove found a poor correlation between FEV_1 measured by routine spirometry and dyspnea assessed by a Borg scale in patients with OLD. Since this study followed the protocol of Wolkove et al, the difference in the results might be due to the difference in the mean age, the degree of airflow obstruction and the use of different instruments to evaluate airflow obstruction of these two studies. The mean age of the patients in this study was only 47 $\pm$ 16.4 years, whereas of Wolkove it was 68 $\pm$ 11 years. Our subjects as a group were less obstructed than the patients with OLD of Wolkove et al. Regarding the instruments, the objective assessment of OLD using spirometer involves extra time and effort. Unlike the spirometer, Mini Wright Peak Flow Meter is a simple device. The procedure involves less time and effort and can be performed during clinical examination. The patients in this study cooperated and performed the test very well.

In this study, a good correlation was also found between DS and WS assessed by the chest physician. Surprisingly the DS was better correlated with WS than PEFR. However, it can not be concluded that WS is better than PEFR in OLD in this study because most of our patients were asthmatic who responded dramatically to bronchodilators[14]. Fair correlation between change in DS and change in PEFR and between change in DS and change in WS after bronchodilator were also found. Relatively few studies have used measures of dyspnea to assess bronchodilator efficacy. Most of the studies have shown poor correlation between subjective and objective parameters[15-18]. Thus, this is one of the few studies that shows a good correlation between subjective and objective data.

Traditionally, chest physicians are accustomed to thinking of patients as "responders" or "nonresponders" based on the pulmonary function outcome or PEFR after inhaled bronchodilator administration[19]. This study supports the study of Wolkove et al in that a similar arbitrary classification can be imposed with respect to dyspnea. When these end points are taken together, four catagories response to either PEFR or dyspnea score, neither or both instead of the customary two are available to define the response to inhaled terbutaline sulphates. Conventional testing, by equating pulmonary function or PEFR improvement with relief of dyspnea or assuming that absence of such response means lack of efficacy, failure to include patients who respond in one or the other parameter only. Twenty - one of 48 initially dyspneic patients in this study had either a dyspnea or bronchodilator response, but not both (Table 3).

The explanation of the relief of dyspnea in 20 patients without a concomittant change in PEFR may be from the placebo or cardiovascular and respiratory muscle beneficial effects of bronchodilators[17,20,21]. However, further studies are necessary before dyspnea scoring can be recommended for clinical assessment in the laboratory.

From all of these results it can be argued that in some individuals the subjective assessment of response to bronchodilator may be at least as valuable as objective data and therefore should not be dismissed. By showing a good correlation

between subjective and objective data, the present study also suggests that the measurement of dyspnea by using dyspnea score is reliable and may be helpful if the objective assessment can not be performed. However, when both assessments include chest physical examination are used together, this combination will allow a more reliable information of the response to bronchodilator in patients with OLD.

SUMMARY

The correlation between subjective and objective assessment of dyspnea before and after bronchodilator in 115 patients with obstructive lung disease attending the chest clinic of Royal Irrigation Hospital, Nonthaburi, Thailand, were investigated. Good correlations were found but subjective assessment (dyspnea score) was better correlated with chest physical examination (wheeze score) than peak expiratory flow rate (PEFR) measured by Mini Wright Peak Flow Meter. Analyzing a subgroup of 48 dyspneic patients revealed the following response groups : those with both a bronchodilator and dyspnea response, either bronchodilator or dyspnea response alone, or neither. The present study suggests that the assessment of dyspnea by using dyspnea score is vital and may be specially helpful in a situation where the objective assessment cannot be performed. In some individuals the subjective assessment of response to bronchodilator may be at least as valuable as objective data.

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ความสัมพันธ์ระหว่าง อาการหอบเหนื่อย, อัตราไหลสูงสุดของลมหายใจออกและเสียงหวีด ในผู้ป่วยโรคปอดอุดกั้น

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ได้ศึกษาความสัมพันธ์ระหว่างอาการหอบเหนื่อย ซึ่งประเมินโดยตัวผู้ป่วยเอง (dyspnea score) กับ อัตราไหลสูงสุดของลมหายใจออก (PEFR) ซึ่งวัดโดย Mini Wright Peak Flow Meter และระหว่างอาการหอบเหนื่อยกับการตรวจทรวงอกฟังเสียงหวีด (Wheeze score) ก่อนและหลังการให้ยาขยายหลอดลมในผู้ป่วยโรคปอดอุดกั้น จำนวน 115 ราย ซึ่งมาพบแพทย์ที่คลินิกโรคปอด โรงพยาบาลชลประทาน นนทบุรี ผลการศึกษาพบว่ามีความสัมพันธ์กันในเกณฑ์ดี แต่ความสัมพันธ์ระหว่างอาการหอบเหนื่อยกับเสียงหวีดจะดีกว่าความสัมพันธ์ ระหว่างอาการหอบเหนื่อยกับอัตราไหลสูงสุดของลมหายใจออก การวิเคราะห์เฉพาะกลุ่มผู้ป่วยที่มีอาการหอบอยู่ก่อน พบว่ามีการตอบสนอง แบ่งเป็น 3 กลุ่มคือ กลุ่มที่มีทั้งการขยายของหลอดลมที่ตรวจวัดได้และอาการหอบเหนื่อยทุเลากลุ่มที่มีอย่างหนึ่งอย่างใดและกลุ่มที่ไม่มีการตอบสนองเลยทั้งสองอย่าง การศึกษานี้ชี้ให้เห็นว่า การประเมินอาการหอบเหนื่อยโดยใช้ dyspnea score ของผู้ป่วยโรคปอดอุดกั้นมีความสำคัญและสามารถนำมาประยุกต์ใช้ในกรณีที่ไม่มีเครื่องมือที่จะช่วยในการตรวจวัดการอุดกั้นของหลอดลมได้ การประเมินอาการหอบเหนื่อยโดยตัวผู้ป่วยเองว่าตอบสนองต่อยาขยายหลอดลมหรือไม่ จึงมีประโยชน์ไม่น้อยกว่าการตรวจวัดค่าการอุดกั้นของหลอดลมโดยใช้เครื่องมือ

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