ASSESSMENT OF LUNG FUNCTION USING AIRFLOWMETER AND FLOSCOPE

P.C. TEOH
B.K. GOH

SYNOPSIS

A comparison has been made of the new instruments, airflowmeter and floscope, with Wright peak flow meter in the assessment of lung function in asthmatics and normal subjects. The measurements made with these two new instruments were found to be in good agreement with the Wright peak flow meter. Additional advantages are small size, light weight, simplicity and low cost and therefore useful in many clinical applications. Unfortunately airflowmeter is not suitable for the use of assessing lung function in patients with severe airways obstruction because of the instrument's high resistance to airflow.

INTRODUCTION

Although measurement of forced expiratory volume in 1 second ($F.E.V._1$) with a spirometer is a very accurate method of diagnosing airways obstruction in pulmonary function laboratory, monitoring of the progress of airways obstruction in patients during treatment could be more conveniently done in doctor's office by frequent measurement of respiratory function with Wright peak flow meter (Fig. 1) which is simple, portable, compact and inexpensive (Wright and McKerrow, 1959). Recently two new devices, the floscope (Fig. 2) and airflowmeter (Fig. 3), were developed for the similar purpose of assessing ventilatory function in patients with obstructive airways disease. They are even more compact and less expensive. Therefore they are not only useful in doctor's office but also suitable for patients to monitor their lung function daily at home while under treatment. This study is designed to find out the suitability and usefulness of these two new instruments by comparing their measurements of respiratory function with that of Wright peak flow meter in asthmatics and in normal subjects.

University Department of Medicine (I)
Singapore General Hospital
Singapore

P.C. Teoh, MBBS, MMED, MRCP, MRACP, AM, FCCP
Associate Professor of Medicine

B.K. Goh
Senior Pulmonary Function Laboratory Technician

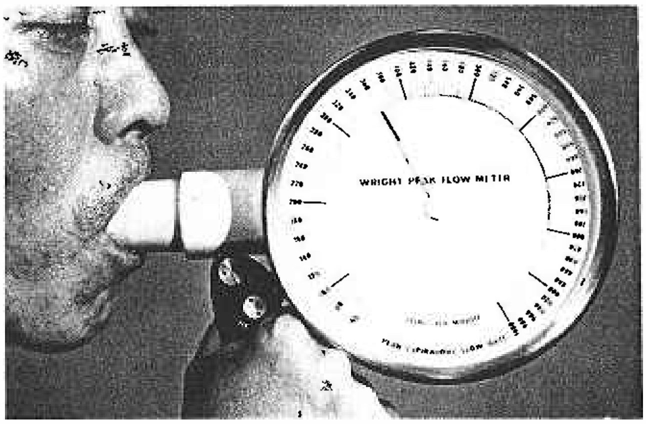

Fig. 1. The Wright peak flow meter in use.

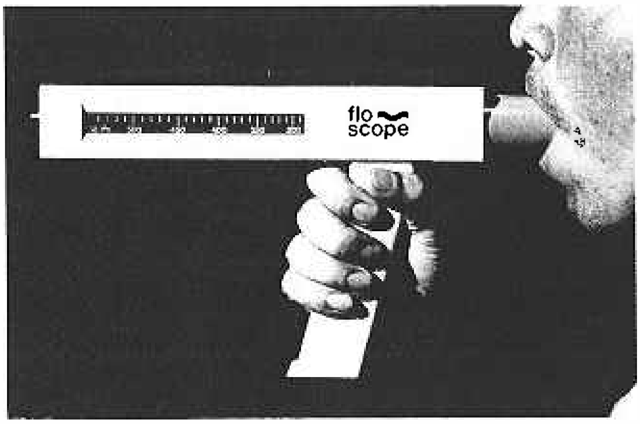

Fig. 2. The Floscope in use.

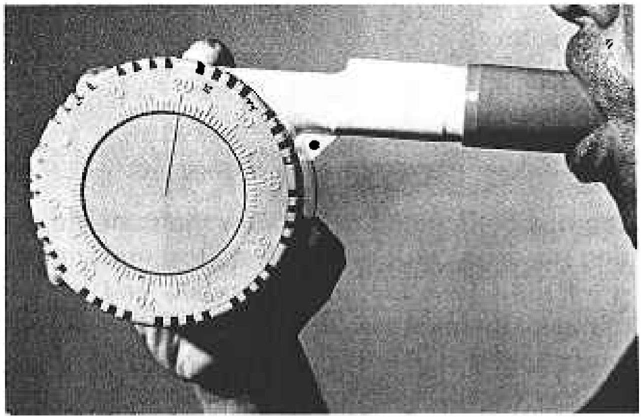

Fig. 3. The airflowmeter in use.

SUBJECTS AND METHODS

50 patients with bronchial asthma attending the Asthma Clinic of Singapore General Hospital and 50 normal subjects comprising of medical students, doctors and technicians in the hospital with no evidence of any respiratory disorders were studied. They were first asked to blow the Wright peak flow meter and three readings were taken. They were then asked to blow the airflowmeter and another three readings were taken. Out of the 50 asthmatics and 50 normal subjects, only 30 each were asked to blow the floscope. Three measurements were again taken. The best of the three readings of each instrument was used in calculation. Measurements were made with the subjects standing unless they were unable to do so. The airflowmeter was used in a similar manner to a spirometer. It was held horizontally; the subject inhaled to vital capacity and then blew as rapidly as possible into the meter. A reading expressed in A.F.M. units was taken when the indicator had come to rest; each complete revolution of the indicator was 100 arbitary units. The floscope was also held by the handle in a horizontal position and was used in a similar manner to Wright peak flow meter. The patient was asked to inhale deeply and exhaled as forcefully as possible into the meter. A reading expressed also as peak expiratory flow rate (P.E.F.R.) was taken when the indicator ring had come to rest.

RESULTS

Table I shows the comparison of mean ($\bar{x}$) and standard deviation (S.D.) of P.E.F.R. (litres/min) measured by Wright peak flow meter with those of A.F.M. units measured by airflowmeter. Fairly good correlation between P.E.F.R. and A.F.M. units in both asthmatics and normal subjects is shown in Fig. 4. The correlation coefficient (r) is 0.92 which is statistically highly significant ($P < 0.001$). The regression line of A.F.M. v. P.E.F.R. however cut the X-axis at the point where the P.E.F.R. is approximately 175 litres/min. This indicates that the airflowmeter has fairly high resistance to blowing when compared with Wright peak flow meter. Table II shows the comparison of mean ($\bar{x}$) and standard deviation (S.D.) of P.E.F.R. (litres/min) measured by Wright peak flow meter with those of P.E.F.R. (litres/min) measured by floscope. The correlation between the findings measured by these instruments is even better (Fig. 5) and the correlation coefficient (r) is found to be 0.98 which is statistically very highly significant ($P < 0.001$). The regression line in this case cut the X-axis at the point where the P.E.F.R. measured by Wright peak flow meter is only approximately 22 litres/min. This indicates that floscope has almost as low a resistance to airflow as that of Wright peak flow meter.

DISCUSSION

Airflowmeter is a very compact and small instrument weighing only 170 gm. It is available locally

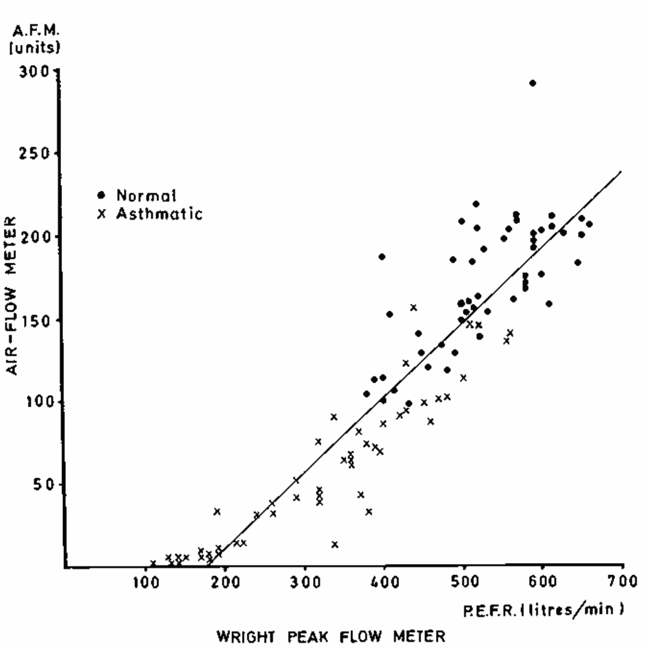

Fig. 4. Correlation between A.F.M. units measured by airflowmeter and P.E.F.R. measured by Wright peak flow meter.

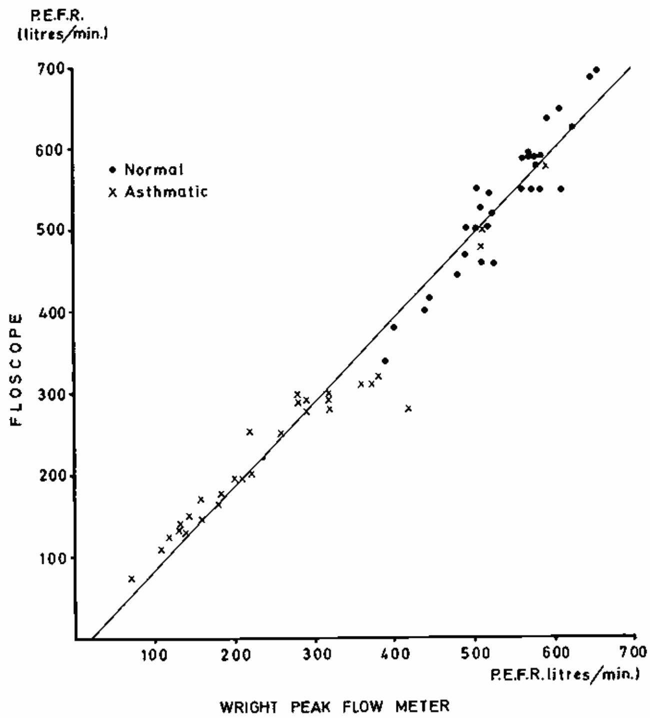

Fig. 5. Correlation between P.E.F.R. measured by floscope and P.E.F.R. measured by Wright peak flow meter.

TABLE I: Comparison of P.E.F.R. (L/min) measured by Wright Peak Flow Meter and A.F.M. units measured by Airflowmeter

Group	Wright Peak Flow Meter			Airflowmeter	
	n	X̄	± S.D.	X̄	± S.D.
Normal	50	529.70	77.29	170.26	39.70
Asthmatics	50	323.10	124.84	56.40	44.91
All Subjects	100	426.40	146.45	113.13	71.08

TABLE II: Comparison of P.E.F.R. (L/min) measured by Wright Peak Flow Meter and Floscope

Group	Wright Peak Flow Meter			Floscope	
	n	X̄	± S.D.	X̄	± S.D.
Normal	30	538.83	67.90	538.66	86.96
Asthmatics	30	262.66	129.01	250.66	121.00
All Subjects	60	419.37	163.42	412.67	171.37

at very low cost (U.S. $20). The meter has a thermoplastic moulded body divided axially into two chambers. In one chamber is a rotating shaft-mounted impeller onto which air is blown tangentially through an inlet. In other chamber a reduction gear driven by the shaft drives an indicator enabling airflowmeter readings to be read from graduations around the edge of the circular cover. The A.F.M. readings are influenced by the flow-rate of the exhaled air as well as its volume (Friedman, 1975). Though the present study shows that there is good correlation between A.F.M. units measured by airflowmeter and the P.E.F.R. measured by Wright peak flow meter, the resistance to blowing in airflowmeter is so great that the regression line of A.F.M. v. P.E.F.R. measured by Wright peak flow meter cuts the axis at the point where the P.E.F.R. is approximately 175 litres per minute. In other words, the patient needs a P.E.F.R. of more than 175 litres per minute before any reading can be obtained with the airflowmeter. This limitation has made airflowmeter unsuitable for use in patients with severe airways obstruction. It was observed during the study that many patients with severe bronchial asthma had great difficulty in blowing the airflowmeter and often it was followed by a bout of coughing and this made the patients more breathless. Therefore the patient's acceptibility of airflowmeter is low comparing with that of Wright peak flow meter.

Floscope is a straight cylinder and the air flow during forced expiration creates a pressure in the spring housing which forces the piston forwards. The distance that the piston travels depends on the pressure building up in the spring housing and consequently will be directly related to the patient's peak flow. The piston drives an indicator ring forward and the position can be read directly in units of litres on the calibrated scale printed on the glass cyclinder (Spitzer and Neuman, 1974). It is also a compact and simple instrument to use. Though its cost is higher than that of airflowmeter, it is still much less expensive than Wright peak flow meter. This study shows that it produces readings of P.E.F.R. which correlate very closely with readings recorded by the Wright peak flow meter. Its resistance to airflow is as low as that of Wright peak flow meter as the regression line of P.E.F.R. (Floscope) v. P.E.F.R. (Wright) cut the axis at the point where the P.E.F.R. (Wright) is only 22 litres per minute. Not only the correlation between the measurements of these two instruments is better than the readings measured by airflowmeter and Wright peak flow meter, the patient's acceptibility of floscope is better than that of airflowmeter.

This study, therefore, shows that measurements of ventilatory function made by these two new instruments, airflowmeter and floscope, correlate well with the measurement made by the Wright peak flow meter in both asthmatics and normal subjects. But unfortunately the airflowmeter, though cheaper in cost, suffers from the limitation of high resistance to air flow therefore makes it unsuitable for use in patients with severe airways obstruction. As for the floscope, it is almost as accurate as the Wright peak flow meter with excellent correlation between their measurements. In addition, it has the advantages of small size, light weight, simplicity and low cost. Therefore floscope is suited to a wide variety of clinical applications. It is useful for studying changes in patients' lung function in doctor's office, suitable for loan to patients to record variation in lung function in their home and useful in survey work.

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