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SPIROMETRIC INVESTIGATION OF RESPIRATORY ILLNESS IN A HOSPITAL POPULATION

by

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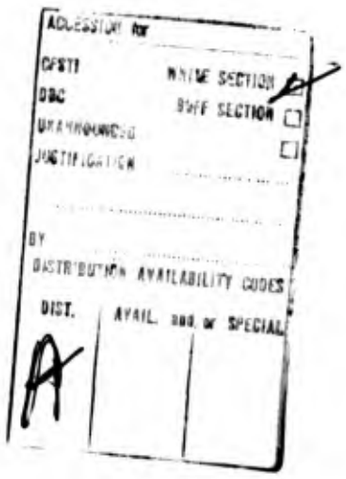

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More than half of the cases were normal on spirograms. About two-thirds of the remainder had obstructive lung abnormality. The others had some restrictive abnormality. Functionally, FEV_1 and $FEV_1\%$ were well matched to the clinical diagnoses.

Follow-up cases, some death cases and some pre-operative cases were reviewed. (Author)

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ABSTRACT

In a three year and five month period, 246 subjects were tested spirographically on 284 occasions. The male to female ratio was three to two. Their ages ranged from 13 to 80 years. Twenty-one patients died. Eight cases were followed every year. Reasons for examinations varied from physical check-ups, to pre-operative evaluation to evaluation of airway obstruction and spirometric study of cardiac cases and so on.

More than half of the cases were normal on spirograms. About two-thirds of the remainder had obstructive lung abnormality. The others had some restrictive abnormality. Functionally, FEV_1 and $FEV_1\%$ were well matched to the clinical diagnoses.

Follow-up cases, some death cases and some pre-operative cases were reviewed.

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I

INTRODUCTION

Although our initial intention was, in part, to perform a more precise study on so-called Tokyo-Yokohama asthma - air pollution asthma - our recent interest has moved into the following points:

1. From the spirometric point of view, how a small hospital population is affected.

2. How related to the pre-operative spirometric study and post-operative course.

3. How patients with obstructive lung disease respond to their ordinary course.

4. Any other interesting finding in a small hospital population.

Considering these points, we have examined a fair number of cases in the three year and five month period for this final and summarized report.

II

METHOD

We have tested patients spirographically for annual physical check-ups, pre-operative pulmonary evaluation, pulmonary evaluation of broncho-pulmonary patients, pulmonary function of cardiac patients and of patients with miscellaneous diseases, from September 1, 1967 to February 15, 1971. These tests have been done in the pulmonary function laboratory in the afternoon by special technicians. Each test was performed in the standing position with the subject sitting in the pause.

Collins 13.5 liter spirometer has been used for vital capacity (VC), forced vital capacity (FVC), and maximal voluntary ventilation (MVV). Each test was performed three times and the best result was taken for the record. Forced expiratory volume in one second (FEV_1) and maximal mid-expiratory flow (MMF) were calculated from the FVC curve.

For predicted values, we used Baldwin's formula[6] from age, sex and height. Peak flow rate was obtained using Wright's flow meter.

In this three blowings were performed and the best one was recorded.

When differential diagnosis of irreversible airway obstruction from a reversible one was necessary, spirometry was tried twice, before and after bronchodilator administration. Bronchodilator was given by intermittent positive pressure breathing apparatus, using Orciprenalin, 0.5%, 0.2 ml with normal saline 1.8 ml.

Clinical diagnosis was made by history, subjective symptoms, physical findings, and laboratory data including roentgenogram, sputum and electrocardiogram. Functional diagnosis was made on the spirograms from their value and the curve. We referred to literature for criteria for classification of every spirographic parameter and partially revised.[3]

III

RESULT

The total number of cases was 246 and tests were performed on 284 occasions on these cases. Eight subjects have been followed every year. We have been able to classify the subjects in Table I through Table III by this real number of subjects (246), but in Table IV through Table VII, we could not classify the records by this number because the spirographic records of these eight subjects varied too much. Some patients showed both obstructive and restrictive type, so consequently the number in Table VIII and Table IX differed from the actual number of cases. The male to female ratio was about 3 to 2. More than two-thirds of the subjects were older than 40 years. The youngest age was 13 and the oldest was 80. (Table I)

In the last year we have tested 86 subjects on 99 occasions. Distribution by age and sex was similar to the whole period.

During this study period, 21 patients died, 17 from cancer of some organ, 3 from chronic obstructive lung disease and 1 from liver cirrhosis.

Twenty-four subjects were examined as a part of a physical check-up. We have called this type of check-up "human dock". This accounts for about 10% of the total cases. Pre-operative spirometric examination was done for 52 cases, most of which were abdominal surgery cases, 19 for stomach cancer, 12 for gastroduodenal ulcer, and 14 for gall stone disease.

Cases of pulmonary tuberculosis varied from minimal to far advanced, most cases being old and not infectious. Simple, acute or non-obstructive bronchitis was present in 22 cases. In the last year there were 12 of this type of patient and this was more than in the first and second years when there were 6 and 4 respectively.

The patients with chronic obstructive lung disease were similar in number every year. The largest number of bronchial asthma cases were examined in the first year.

Pneumonia, pulmonary fibrosis from various origins, bronchogenic cancer, pleural thickening and bronchiectasis were the main diseases in the group of "other pulmonary disease". In the last year these patients numbered more than in other years. Ten patients listed as having heart disease had valvular disease. Cases with liver disease were of the highest number in the miscellaneous disease group. Every year we had the same number in this group. (Table II)

About two-thirds of the subjects showed normal values of vital capacity. In the last year the subjects with normal VC were 58% of the cases, less than the previous years' values. Contrarily, the subjects with the lowest predicted value (less than 49% of predicted value) increased over the previous ones. (Table III)

FEV_1 and $FEV_1\%$ were normal (more than 1.75 liters and more than 71% respectively) in about 60% of the cases. This tendency did not change remarkably in the last year. (Table IV)

Averaging the total number of cases, those with normal MVV% were about 40% of the total, though in the last year it was about one-third. The lowest MMV%, less than 49%, was about one-fourth of the total. (Table V)

About three-fourths of the subjects showed normal MMF. Severely reduced MMF was shown in only a few. (Table VI)

About 60% of the cases showed more than 300 liter/min. on peak flow rate. The cases with poor value were less than 5%. This tendency was the same in the last year. (Table VII)

Approximately half of the cases showed normal spirograms. About one-sixth of the subjects showed mild obstructive type. Restrictive cases were about half of the obstructive cases. These tendencies were the same in cases in the last year. (Table VIII)

In mild obstructive lung diseases, age distribution was about the same in both sexes. In the moderately obstructive group, the high age

group possessed a larger number than the younger group. There was no patient with severely obstructive lung disease under 19 years of age.

IV

DISCUSSION

Considering Table I and Table II, the peak age distribution was in the fourth and fifth decade and three-fifths of them were male. Following are a few of the reasons:

1. So called human dock has been performed for male executives of the same social background and their ages are generally more than the fourth decade.

2. Most pre-operative cases were stomach cancer, stomach ulcer and cholelithiasis. Their ages, also, were usually more than 40 years.

3. Patients with chronic obstructive lung disease were, again, more than the fourth decade.

4. More than half of the miscellaneous diseases were liver disease, mainly liver cirrhosis, and usually their ages were not of the younger years.

5. This is not for medical reasons, but most female subjects and subjects older than 60 years, are not employed regularly. Consequently, because they would have to pay cash at the hospital, not being fully covered by employees' insurance, they might hesitate to visit the hospital until their disease becomes too severe to continue daily life at home without help.

Subjects with normal vital capacity accounted for about two-thirds. This was due to the following reasons:

1. Almost all of the human dock cases were healthy persons.

2. Most pre-operative patients had abdominal diseases and their lungs were not directly involved.

3. Patients with simple or non-obstructive bronchitis and patients with bronchial asthma were tested in the convalescent stage.

4. This was also true for cardiac cases.

5. Most patients with miscellaneous diseases had no lung involvement, at least not spirographically.

Classifications by FEV_1 and $FEV_1\%$ were well matched. These classifications were also fairly well matched with VC%. This is understandable because FEV_1 is reduced to some extent, its FVC should be reduced and this projects to VC (inspiratory).[5]

As we mentioned in our previous report [1] and [2], MVV depends upon subject's cooperation, which if it is poor, gives results which are unreliable. This cooperation closely relates to the technician's instruction and if this is insufficient, the subject would not be able to cooperate fully. In this testing, explanation by our technician was probably poor because in the oxer-all result, MVV% did not match FEV_1, $FEV_1\%$ and MMF. Of course, MMV is a mixed indicator for obstructive and restrictive type. Even so, the number of normal MVV% was small in comparison with the other parameters.

In classification by functional diagnosis, the normal group was about 55%. Since mild obstructive group often showed normal VC%, this classification fairly well matched the classification by VC%. As discussed above, the group of moderately and severely obstructive disease, very often showed reduced VC and some cases had both obstructive and restrictive type of disease. The other groups on functional diagnosis were well matched with the classification by VC%, FEV_1 and $FEV_1\%$.

We were able to follow three patients with chronic obstructive lung disease. Their FEV_1 was steadily declining each year. Of course, some part of this decline was caused by the aging process, but patient A showed 0.37 liter reduction per year. This is definitely due to disease process and his final FEV_1 was only 0.74 liter and his prognosis is not good.[4] Reduction rates of two other patients was not so big and their final FEV_1 was more than 1.25 liters, so their prognosis is not as poor as for A. Five other subjects whose spirograms were followed for three years were stable or variable depending upon their disease or reason for examination.

In the last year, two patients with chronic obstructive lung disease died. One patient, age 66, had bronchitic type of chronic obstructive lung disease with diabetes mellitus for years. Three days prior to his death, acute exacerbation occurred. He had been a pharmacist so was taking some drugs, though he had been followed by our outpatient clinic. In the morning of his death when he was going to the toilet, his respiration suddenly stopped and he lost consciousness. When he was brought to our hospital by ambulance, we found his pulse did not palpate. Immediately every kind of intensive treatment was tried but respiration and heart beat did not return.

The other patient was a 67 year old female who was seen in our Outpatient Clinic one year and three months before her death. For ten months she had been treated here. Four months prior to her death dyspnea became worse so that she had to be admitted. Antibiotics, expectorant and bronchodilator relieved her. Fifteen days prior to her death, she was readmitted to intensive care unit because of dyspnea and difficulty of expectoration. Tracheal intubation was performed and mechanically assisted breathing was started with administration of antibiotics, bronchodilator and fluid therapy, but every kind of treatment failed and she died in comatous condition.

FEV_1 of first patient was 0.89 liters and second patient's was 0.35 liters, 1.5 months and 5 months prior to their deaths respectively. Thus FEV_1 tells us the prognosis.[4]

We examined 30 cases of bronchial asthma, but when spirogram was performed, their asthmatic state had been improved. Consequently, the result almost always showed mild to moderately obstructive pattern rather than severely obstructive. Thus, we can see on Table IX that severe obstructive group was not big in number, especially in younger age group. This is partially true for cardiac cases. When a valvular patient comes into the hospital for congestive heart failure, we can not immediately examine by spirogram but can only examine after recovery, then we can see only slight abnormality on the spirogram.

Mr. S.A., aged 65, who was going to be operated on for stomach ulcer suffered from pulmonary tuberculosis twenty years ago and thoracoplasty was performed at that time. His spirogram showed VC 1.76 liters, VC% 54%, MVV 53.3 liters/min., MVV% 73%, FEV_1 1.23, FEV_1% 70%, MMF 1.6 liters, PFR 120 l/min. The operation was postponed and we discussed the operability and then spirography was again performed. VC 2.03 liters, VC% 63%, MVV 58.6 liters/min., MVV% 62%, FEV_1 1.42 liters, FEV_1% 70%, MMF 20, PFR 320 liters/min. were the results. Moderately severe restrictive and very mild obstructive abnormality was found. Operation was done, post-operative care including exercise was intensively done. We found no complication occurred. Usually, when we find any moderate, either restrictive or obstructive lung disease on spirogram, we are reluctant to perform surgery because of probable post-operative pulmonary complication. However, in this special case, malignancy was highly suspected so that the operation was done at some poor risk. The specimen pathology turned out to be benign stomach ulcer.

Mr. Y.B., age 64, had benign stomach ulcer roentgenologically and endoscopically, but he had had chronic productive cough and he had been a heavy smoker. Spirogram showed VC 2.84 liters, VC% 75%, MVV 59.1 liters/min., MVV% 62%, FEV_1 1.78 liters, FEV_1% 62%, MMF 1.8 liters,

PFR 240 liters/min. According to our criteria for abnormal spirogram, this patient showed border line abnormality, so pre-operative airway cleaning by antibiotics, bronchodilator and expectorant was done.

Thus, pre-operative spirographic examination is good as a guide for risk and post-operative course. Similar cases were mentioned in the previous report.[2]

V

CONCLUSION

1. Two hundred forty-six cases were tested on 284 occasions in a three year and five month period. One hundred thirty-eight cases were diagnosed on spirograms as normal. Though some cases had both obstructive and restrictive type, 83 cases were obstructive and 30 cases were restrictive type.

2. Both clinical and functional diagnoses correspond fairly well.

3. Recent death cases with chronic obstructive lung disease, follow up cases with chronic obstructive lung disease and pre-operative cases were reviewed.

TABLE I

Distribution by Age, Sex

Age	Male		Female		Total	
- 19	2	(2)	3	(3)	5	(5)
20 - 39	30	(31)	33	(40)	63	(71)
40 - 59	61	(78)	36	(42)	97	(120)
60 -	56	(63)	25	(25)	81	(88)
Total	149	(174)	97	(110)	246	(284)

( ) = Actual number of tests done

TABLE II

Classification by reason for Examination

Diagnosis or Examination		
Routine Physical Examination or Human Dock	24	76
Pre-operative Evaluation	52	
Pulmonary Tuberculosis	9	122
Simple or Acute Bronchitis	22	
Chronic Obstructive Lung Disease	36	
Bronchial Asthma	30	
Other Pulmonary Diseases	25	
Heart Diseases	17	
Miscellaneous Diseases	31	
Total	246	

TABLE III

Classification by Vital Capacity % of Predicted Value

VC %	Number		% in Total Cases
> 80	163	(173)	65.3
79 - 65	45	(56)	18.9
64 - 50	31	(44)	12.6
49 >	7	(11)	3.2
Total	246	(284)	100.0 %

( ) = Actual number of tests done

TABLE IV

Classification by FEV_1 and $FEV_1\%$ of VC

FEV_1	Cases (Tests)	% in cases	$FEV_1\%$	Cases (Tests)	% in cases
> 1.75	159 (167)	62.6	71%	152 (164)	59.8
1.75 > 1.25	49 (59)	19.4	70 - 56%	59 (67)	23.2
1.25 > 0.75	31 (38)	12.1	55 - 41%	27 (35)	10.6
0.75 >	15 (20)	5.9	40%	16 (18)	6.4
Total	254 (284)	100.0	Total	254 (284)	100.0

TABLE V

Classification by MVV% Predicted

%	Cases	(Tests)	% in cases
80	105	(113)	41.4
79 - 65	45	(48)	17.7
64 - 50	42	(45)	16.5
49 -	62	(78)	24.4
Total	254	(284)	100.0

TABLE VI

Classification by MMF

Volume	cases	(Tests)	% in cases
$\geq$ 1.5	187	(203)	73.6
1.5 $>$ $\geq$ 0.85	35	(41)	13.8
0.85 $>$ $\geq$ 0.35	22	(27)	8.7
0.35 $>$	10	(13)	3.9
Total	254	(284)	100.0

TABLE VII

Classification by Peak Flow Rate

Volume	Cases	(Tests)	% in cases
> 500	29	(30)	11.4
499 - 400	54	(58)	21.3
399 - 300	76	(82)	29.9
299 - 200	47	(53)	18.5
199 - 100	37	(47)	14.6
99 >	11	(14)	4.3
Total	254	(284)	100.0

TABLE VIII

Classification by Functional Diagnosis

		Cases	(Tests)
Normal		138	(145)
Obstructive	Mild	47	(55)
	Moderate	20	(27)
	Severe	16	(22)
Restrictive	Mild	16	(23)
	Moderate	13	(20)
	Severe	1	(1)

TABLE IX

Distribution of Subjects by Age, Sex, of Obstructive Type

Grade	Age	Male		Female		Total	
Mild	19	0	23	1	24	1	47
	20 - 39	4		5		9	
	40 - 59	10		11		22	
	60 -	9		7		17	
Moderate	19	1	12	0	8	1	20
	20 - 39	0		1		2	
	40 - 59	1		2		4	
	60 -	10		5		15	
Severe	19	0	9	0	7	0	16
	20 - 39	1		3		4	
	40 - 59	4		3		7	
	60 -	4		1		6	
Total			44		39		83

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