

'Bronchitis' in patients with mitral stenosis

CLIVE P. ABER

From the Liverpool Royal Infirmary

Episodes of 'recurrent bronchitis' following minor upper respiratory tract infections are common in patients with mitral stenosis. The first incident of this type is often found in retrospect to mark the onset of progressive deterioration in exercise tolerance.

The clinical features of 'bronchitis' in these patients, however, frequently differ from those of true purulent bronchitis. There may be little, if any, infection of the sputum, and pyrexia is either absent or unimpressive. Orthopnoea is commonly present, and the response to routine therapy with antibiotics and bronchodilator drugs is slow and incomplete, leaving a wheezy chest for several weeks. On the other hand, there is no doubt that purulent bronchitis and emphysema do occur in patients with mitral stenosis.

It is of the utmost importance, therefore, when assessing patients for mitral valvotomy to be able to separate these two groups since it is essential to know how much respiratory disability is due to the pulmonary consequences of mitral valve obstruction and how much is caused by true bronchitis and/or emphysema. In this way, both the operative risks and the likelihood of being able to provide maximum benefit from this type of operation can be assessed more accurately. Similarly, physiological information that separates these two groups of 'bronchitic cardiac patients' can guide the post-operative management of patients in the true bronchitic and emphysematous group where elective tracheostomy and/or assisted ventilation may save a life (Temple, 1961).

The present investigation was designed to compare the pulmonary function of patients with mitral stenosis who had experienced recurrent bronchitis with that of patients with mitral stenosis who had never experienced symptoms of this nature.

MATERIAL AND METHODS

Included in this study were 84 patients, 69 women and 15 men, with dominant mitral stenosis, who all subsequently had a mitral valvotomy.

Each patient was placed in one of five grades (0 to IV) according to the pre-operative functional

incapacity, using the New York Heart Association Classification (1945). On this basis, there were no patients in grade 0; five patients, two men and three women, in grade I; 38 patients, six men and 32 women, in grade II; 35 patients, four men and 31 women, in grade III; and six patients, one man and five women, in grade IV.

Thirty-eight of the 84 patients (45.2%) gave a history of recurrent bronchitis for at least two years before admission to hospital, 24 for over five years and eight for 10 years or more. Twenty-six had wheezy chests at the time this investigation was performed.

No patient with a history of primary respiratory disease was admitted to this series and none had either clinical or radiological evidence of emphysema.

METHODS The following lung function tests were carried out on the patients at rest in the sitting position. The vital capacity (V.C.), the forced expiratory volume over one second (F.E.V.₁), the maximum inspiratory and expiratory flow rates (M.I.F.R. and M.E.F.R.), and the maximum voluntary ventilation (M.V.V.₉₀) were measured, using a low resistance spirometer (Bernstein, D'Silva, and Mendel, 1952). In 28 patients, 17 bronchitic and 11 non-bronchitic, these spirometric measurements were repeated after the subcutaneous administration of a bronchodilator drug, adrenaline hydrochloride, 0.3 mg.

The residual volume (R.V.) was determined by closed-circuit helium dilution method (Weiner and Cooper, 1956). The intrapulmonary (alveolar) mixing efficiency (M.E.%) was then calculated (Bates and Christie, 1950).

Predicted normal values for the lung volumes, maximum voluntary ventilation, and intrapulmonary mixing efficiency were calculated from the simplified regression formulae of Needham, Rogan, and McDonald (1954).

In 63 patients direct mean left atrial and pulmonary artery pressures were obtained at thoracotomy through a 21-gauge needle connected with a saline manometer by a metre of hardened nylon tubing of 1.5 mm. bore.

RESULTS

Neither sex nor age seemed to influence the incidence of recurrent bronchitis in any grade or functional incapacity. The greater the disability, however, the more likely were such symptoms to be present (Table I).

TABLE I

THE INCIDENCE OF RECURRENT BRONCHITIS RELATIVE TO FUNCTIONAL INCAPACITY IN 84 PATIENTS WITH MITRAL STENOSIS

Functional Status	Non-bronchitic Patients		Bronchitic Patients	
	No.	%	No.	%
Group I	5	100	0	0
Group II	23	60.5	15	39.5
Group III	17	48.6	18	51.4
Group IV	2	33.3	4	66.6

LUNG VOLUMES The residual volume was raised to 120% or more of the predicted normal value in 16 patients, only six of whom were in the bronchitic group. Similarly, the expiratory reserve volume was significantly increased in 22 patients, seven of whom were bronchitic.

At all levels of mean pulmonary artery and left atrial pressures the residual volume and expiratory reserve volume were similar in both groups (Figs. 1 to 4). However, the residual volume was never significantly increased when the mean pulmonary artery pressure was less than 20 mm. Hg or greater than 40 mm. Hg (Fig. 1). A similar relationship was observed, with one exception, between the expiratory reserve volume and the mean pulmonary artery pressure (Fig. 3).

The ratio of the residual volume to the total lung capacity (T.L.C.) was similar for both groups of patients with grade II and grade III functional incapacity, but this ratio was higher in the non-bronchitic patients in grade IV (Table II).

VENTILATORY CAPACITY The non-bronchitic and bronchitic patients in each grade of functional

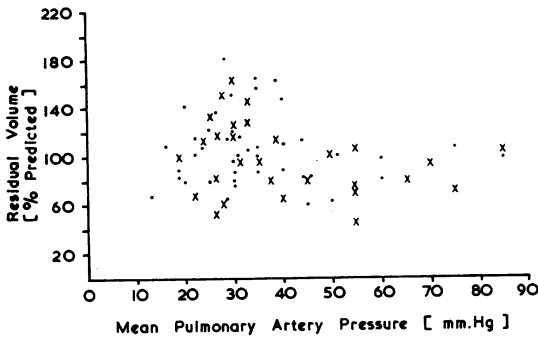


FIG. 1

FIG. 1. The relationship of the residual volume to the mean pulmonary artery pressure in patients with mitral stenosis.

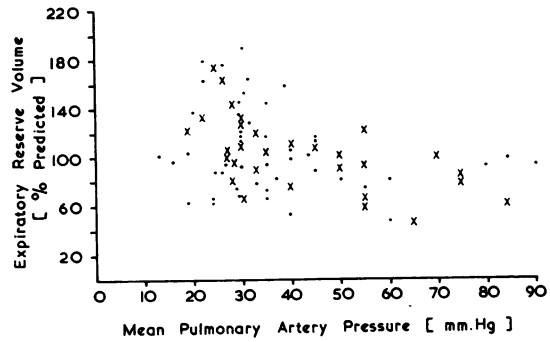


FIG. 3

FIG. 3. The relationship of the expiratory reserve volume to the mean pulmonary artery pressure in patients with mitral stenosis.

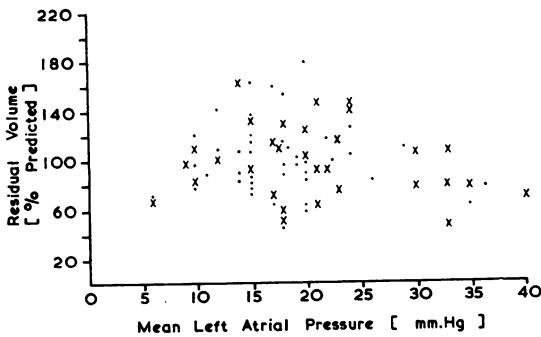


FIG. 2

FIG. 2. The relationship of the residual volume to the mean left atrial pressure in patients with mitral stenosis.

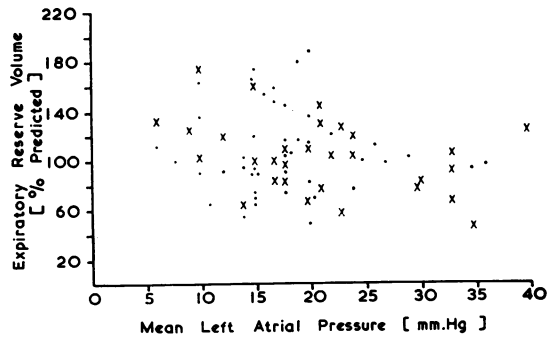


FIG. 4

FIG. 4. The relationship of the expiratory reserve volume to the mean left atrial pressure in patients with mitral stenosis.

● = non-bronchitic patient. x = bronchitic patient.

TABLE II
VENTILATORY CAPACITY OF NON-BRONCHITIC AND BRONCHITIC PATIENTS WITH MITRAL STENOSIS RELATIVE TO FUNCTIONAL INCAPACITY

		<i>Functional Status</i>							
		<i>Group I</i>		<i>Group II</i>		<i>Group III</i>		<i>Group IV</i>	
		<i>Mean</i>	<i>Range</i>	<i>Mean</i>	<i>Range</i>	<i>Mean</i>	<i>Range</i>	<i>Mean</i>	<i>Range</i>
F.E.V. ₁ (%)	Non-bronchitic	78	62-95	73.5	64-94	69.0	61-88	70	63-77
	Bronchitic	—	—	70.5	46-86	69.0	42-83	64	36-72
M.V.V. ₈₀ (% predicted)	Non-bronchitic	95	70-112	94.0	71-125	75.5	65-104	76	60-78
	Bronchitic	—	—	88.0	50-95	82.0	43-98	64	40-79
M.I.F.R./M.E.F.R.	Non-bronchitic	1.26	0.9-1.52	1.04	0.92-1.8	1.25	1.0-1.7	1.56	1.3-1.9
	Bronchitic	—	—	1.04	0.82-2.2	1.19	1.2-3.0	1.87	1.2-3.2
R.V. T.L.C.(%)	Non-bronchitic	31.0	25-35	39.0	25-49	41.5	27-50	45.0	29-50
	Bronchitic	—	—	38.0	23-60	40.0	27-58	40.0	25-65
M.E.(%)	Non-bronchitic	81	59-110	75	63-120	68	60-115	85	53-108
	Bronchitic	—	—	79	40-99	88	36-122	66	30-89

incapacity had very similar mean indices of ventilatory capacity (Table II). Five of the bronchitic group, two men and three women, however, showed evidence of an appreciable degree of obstructive pulmonary disease; one patient was from grade II, two patients from grade III, and two patients from grade IV (Table III).

The response to the subcutaneous administration of a bronchodilator drug was similar in both

groups, being variable and unpredictable. Thus, whereas in some patients there appeared to be a significant improvement in the maximum voluntary ventilation, this type of response was inconstant, and, when present, was not usually associated with improvement in the other indices of ventilatory capacity except in one instance (no. 49, Table IV). This patient later admitted to having had attacks of 'bronchial asthma' from 7 to 10 years of age but she had been free from

TABLE III
VENTILATORY CAPACITY OF PATIENTS WITH UNCOMPLICATED MITRAL STENOSIS, RECURRENT BRONCHITIS AND MITRAL STENOSIS, AND OBSTRUCTIVE PULMONARY DISEASE AND MITRAL STENOSIS

	<i>F.E.V.₁(%)</i>	<i>M.V.V.₈₀ (% Predicted)</i>	<i>M.I.F.R. M.E.F.R.</i>	<i>R.V. T.L.C.</i>	<i>M.E.(%)</i>
Mitral stenosis (46 patients)	72	74	1.2	38	70
Bronchitic mitral stenosis (33 patients)	70	70	1.3	39	82
Mitral stenosis with obstructive pulmonary disease (5 patients)	42	46	2.8	60	35

TABLE IV
VENTILATORY RESPONSE OF NON-BRONCHITIC AND BRONCHITIC PATIENTS WITH MITRAL STENOSIS TO 0.3 MG. ADRENALINE HYDROCHLORIDE

<i>Functional Status</i>	<i>Non-bronchitic Patients</i>			<i>Bronchitic Patients</i>		
	<i>Increase in M.V.V.₈₀ (as % Normal)</i>	<i>Change in M.I.F.R./M.E.F.R. Ratio</i>	<i>Change in F.E.V.₁ (as % Normal)</i>	<i>Increase in M.V.V.₈₀ (as % Normal)</i>	<i>Change in M.I.F.R./M.E.F.R. Ratio</i>	<i>Change in F.E.V.₁ (as % Normal)</i>
Group I	0	-0.16	-5			
	11	-0.12	+2			
Group II	6	-0.07	+5	9	+0.14	-1
				24	+0.11	0
	10	0	-2	29	-0.32	+1
				0	0	+3
	3	-0.05	+2	5	-0.07	-3
Group III				28	0	-19
	33	-0.13	-7	14	-0.21	+8
				30 (No. 49)	-1.02	+15
	15	-0.16	+9	11	+0.08	0
	7	+0.06	-7	40	-0.01	+14
	0	-0.07	+2	12	+0.38	-2
	41	0	-4	19	+0.81	+2
	23	-0.05	+2	13	+0.37	-8
Group IV				40	+0.10	+4
				15	+0.09	-2
				28	+0.07	+1
			37	-0.57	+7	

respiratory symptoms for 25 years before the onset of the heart trouble.

MIXING EFFICIENCY A significant disturbance of gaseous mixing was shown in seven patients, five of whom had evidence of appreciable obstructive pulmonary disease (Tables II and III).

POST-VALVOTOMY MANAGEMENT An elective tracheostomy was performed after completion of the valvotomy on the five patients who had evidence of obstructive pulmonary disease. Four of them subsequently required assisted ventilation for periods varying from 12 to 72 hours. All these patients had an appreciable degree of mitral stenosis (valve diameter 1.5 cm. or less) and subsequently gained considerable benefit from the operation.

DISCUSSION

Although no comparable study has previously been made, the present results confirm observations made by several other workers that in patients with mitral stenosis there is usually no evidence of a significant degree of airway obstruction despite the presence of a wheezy chest on auscultation (Carroll, Cohn, and Riley, 1953; Clowes, Hackel, Mueller, and Gillespie, 1953; Curti, Cohen, Castleman, Scannell, Friedlich, and Myers, 1953; West, Bliss, Wood, and Richards, 1953; Friedman, Macias, and Yu, 1959). It is not clear why these patients should have wheezy chests and complain of frequent recurrent bronchitis following minor upper respiratory tract infections. Such infective episodes probably provoke congestive oedema of the bronchial mucosa but fail to produce permanent structural damage in the bronchial walls or emphysema in the distal lung tissue. The disappearance of respiratory incidents of this nature after successful mitral valvotomy tends to support this concept.

Occasionally, however, simple pulmonary function tests, such as F.E.V.₁%, M.I.F.R./M.E.F.R., and M.V.V.₈₀, reveal a significant degree of airway obstruction in the bronchitic group. If mitral valvotomy is attempted in such patients, in an endeavour to achieve worth-while, albeit incomplete, symptomatic improvement, elective tracheostomy is advisable. Assisted ventilation can then be commenced, if required, with a minimum of inconvenience to both patient and staff.

The reason for the observed increase in maximum voluntary ventilation after the administration of adrenaline hydrochloride in both the non-bronchitic and bronchitic patients in this series is not known. It may have been due to the

non-specific psychological and physical boosting effect of this drug.

Finally, it should be appreciated that in uncomplicated mitral stenosis the residual volume is commonly raised when the mean pulmonary artery pressure is between 20 and 40 mm. Hg. This disturbance of pulmonary function might otherwise erroneously suggest the presence of emphysema in a wheezy and bronchitic patient. However, the associated findings of an increased expiratory reserve volume under such circumstances and a lack of evidence of airway obstruction should prevent this mistake from being made.

SUMMARY

Pulmonary function studies were performed on 46 patients with uncomplicated mitral stenosis and on 38 patients with mitral stenosis who had experienced recurrent bronchitis for more than two years before mitral valvotomy.

There was no objective evidence of obstructive pulmonary disease in most of these patients despite wheezy chests in 71% of the bronchitic group and frequent elevation of the residual volume in both groups.

Simple spirometric measurements of F.E.V.₁%, M.I.F.R./M.E.F.R., and M.V.V.₈₀ revealed a significant degree of airway obstruction in only five of the bronchitic patients. Elective tracheostomy was performed on these patients, four of whom also required assisted ventilation in the post-operative period.

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