SERIAL ELECTROCARDIOGRAMS IN COR PULMONALE WITH CHRONIC OBSTRUCTIVE LUNG DISEASE

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We have previously reported on a predominantly retrospective study of the electrocardiogram in Cor Pulmonale with chronic obstructive lung disease (Toh, B.H. and Da Costa, J.L., S.M.J., 1968) where it was suggested that the E.C.G. could be graded into 3 stages:-

Grade I: Verticalisation of the mean QRS vector with other features of 'emphysema'.

Grade II: Right axis deviation of more than +110° with dominant R in aVR.

Grade III: Right axis deviation of more than +110° with dominant R in aVR plus anterior direction of the mean QRS vector with dominant R in V1.

The present paper is a report on serial electrocardiograms in 6 patients in which a transition through our suggested 3 stages appears to have taken place.

MATERIALS AND METHODS

Selection of Patients

6 patients were studied, 3 being retrospective patients and 3 prospective patients (these being part of a larger series studied by J.L. DC). The period of observation during which the E.C.G. changes were noted varied between 1 and 7 years.

Criteria for Diagnosis

In the retrospective series the criteria for diagnosis were similar to those used in our previous study, that is, autopsy evidence of emphysema and right ventricular hypertrophy (Toh, B.H. and Da Costa, J.L., S.M.J., 1968). In the prospective series the criteria for diagnosis of:

1. Chronic Obstructive Airways Disease was based on the history, clinical examination, X-ray examination of the chest and lung function studies.
2. Right ventricular hypertrophy was based on the electrocardiographic criteria stated previously.

Recording of Electrocardiogram

A 12 lead electrocardiogram (3 standard leads, 3 unipolar leads and 6 praecordial leads taken in the standard positions) was recorded with a direct writing Cambridge Electric Cardiograph. The following observations were recorded:

1. The frontal P axis (Ā P) calculated by the method of Grant (1957).
2. (i) The P configuration in Leads II, III, and aVF.
   (ii) The P configuration in Leads V2 and beyond.
3. The frontal plane QRS axis (Ā QRS) calculated by the method of Grant (1950).
4. The QRS configuration in the following leads:
   (a) aVR
   (b) V4R (only in the prospective series)
   (c) V1
   (d) V5
5. The position of the transitional QRS complex in the praecordial leads.
6. T inversion
7. Lead I sign (Isoelectric P, QRS less than 1.5 mm and T less than 0.5 mm) Fowler, 1965.

RESULTS AND DISCUSSION

The electrocardiographic features in the 6 patients are tabulated in Table 1. 3 patients progressed from Grade I to II, and 2 patients progressed from Grade II to III. It is interesting to note that in 1 of our patients (Case No. 5, TPS) transition from Grade I through II and then to III is seen and also in this patient the

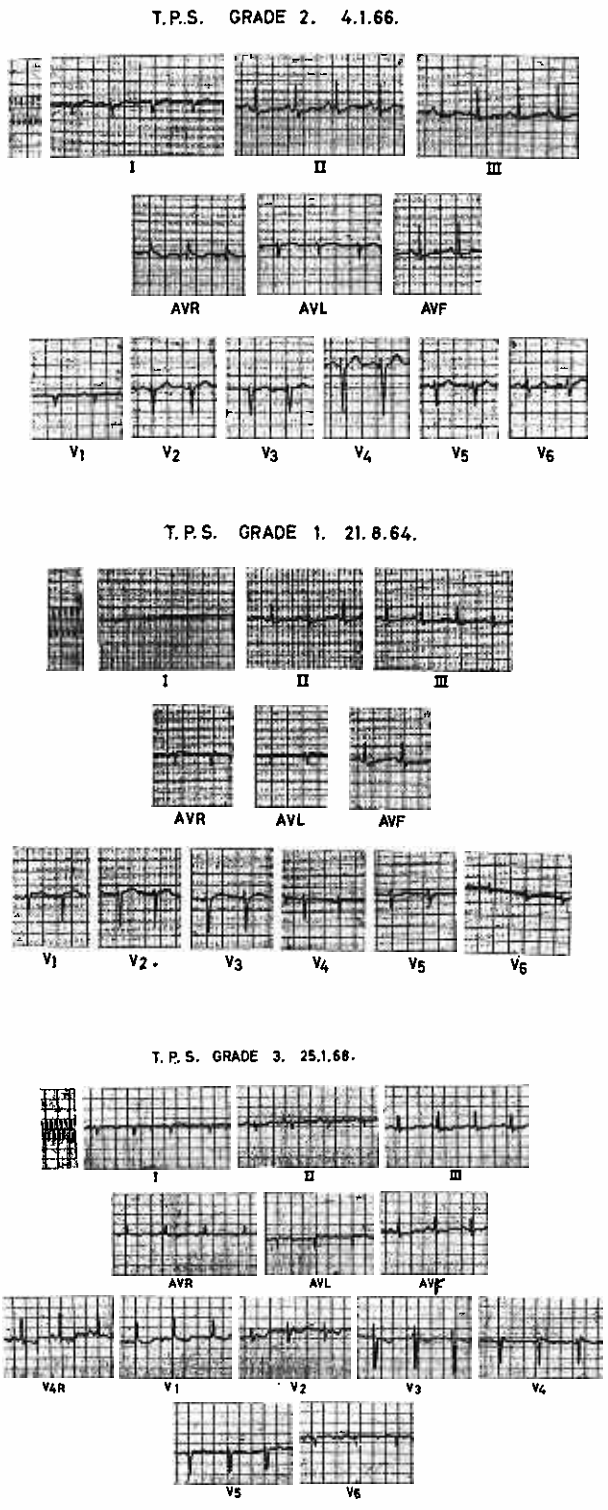

Fig. 1.

transitional complex moved from V5-6 through V6, and then beyond V6 during the same period (Fig. 1).

In a larger series of prospective cases being followed up by one of us (J.L. DC) we have observed that in most cases the E.C.G. remains "stagnant" at Grade I, i.e. there is only verticalisation of the QRS axis ($\bar{A}$ QRS = 90°) even after periods of follow-up of up to 5 years. However, in a small minority of cases the E.C.G. shows a progression—the mean QRS vector after becoming vertical turns rightward first before it becomes anteriorly-directed. This observation was first made by Phillips (1958).

It is interesting to speculate on the possible factors that may influence the direction of the mean QRS vector. Burrows et al., (1964; 1966) in an Anglo-American study of chronic obstructive lung disease distinguished between "emphysematous", "bronchial" and a mixed group, on clinical, radiological and physiologic grounds. They also found that cor pulmonale was more frequent in the 'bronchial' group. The reasons for this are still obscure but recent work by Filley et al., (1966) suggests that a number of factors are involved. It has been shown that not only is arterial hypoxemia and pulmonary hypertension greater in the 'bronchial' than in the 'emphysematous' group but also usually the total blood volume and cardiac output (Filley, 1967). The work of the heart in the 'bronchial' group may thus be so increased that right ventricular hypertrophy and congestive failure is more frequent—in the words of Sir Thomas Lewis (1934) "failure with congestion is not determined by emphysema in such cases but by bronchitis".

Grant (1957) has suggested that the 'verticalisation' of the mean QRS axis may be due to the marked reduction in electrical conductance in the emphysematous lung. In effect this causes the axes for Leads II and III to be shifted so that they run vertically through the mediastinum instead of obliquely across the chest. As a result Lead II and Lead III record only the superiorly or inferiorly directed components of the QRS vectors which the heart is generating; this tends to 'verticalise' the QRS loop. Thus even a slight rightward direction of the mean QRS vector would be recorded as a vertical mean QRS vector and mild right ventricular hypertrophy which may be found in the 'emphysematous' group may be masked by the emphysematous lung. On the other hand, the 'bronchial' and 'mixed' groups with their possibly greater degree of right ventricular hypertrophy and concommitant lesser degree of emphysema would thus tend to show more overt changes of right ventricular hypertrophy in the E.C.G.

SUMMARY

Observations on 6 patients with serial electrocardiograms observed over periods varying from 1 to 7 years are reported.

TABLE. I

CASE No.	DATE	$\hat{A}P$ +	P. CONFIGURATION			$\hat{A}QRS$	aVR		V4R		V1		V5		TRANS. COMPLEX	ST-T↓	LEAD I SIGN	GRADE
			Pulm.	Gothic.	Cupula.	+	+	−	+	−	+	−	+	−				
1. N.C.H	20.10.66.	90	3 3 3			95		Qs		rS		rS	Rs		V4	+	+	I
	7. 3. 67.	90	3 3 3			110	qR			rS		rS		QS	V6	+	+	II
2. C H.P	4. 9. 62	90	4 4 4			110		QS				rS		rS	>V6	+	0	I
	8. 1. 63	90			0.5 0 5 0.5	120	R					rS		rS	>V6	0	0	II
3. L.L.P	8.11. 60	90	2.5 2.5 2.5			110		QS				rS		rS	V5 - V6	0	+	I
	20. 8. 61	90	5.5 5.5 5.5			120	qR					rS		rS	>V6	0	+	II
	24. 8. 67	90	2.5 2.5 2.5			115	qRs					rS		rS	>V6	+	+	II
4. T. K. C.	20. 3. 63	80	4 4 4			130	qR					rS		rS	>V6	+	0	II
	28.10.66	80	5 4 5			157	qR			rS		QS		QS	>V6	+	0	II
	28. 3. 67	90	5 5 5			180	R		Rs			rS		QS	>V6	+	0	III
5. T. P. S.	21 8.64	90			1 1 1	90		Qr				rS		rS	V5 - V6	0	+	I
	4. 1. 66	90		2 2 2		115	qR					rS		rS	V6	0	0	II
	16 2 66	90		1.5 1.5 1.5		120	qR				R			rS	>V6	+	+	III
6. W.b.A.	25.3.63	90		2 2 2		140	qR					rS	Rs		V4 - V5	0	0	II
	8. 4. 67	90			0 30. 30. 3	150	qR				qR			rS	>V6	+	0	III
	18. 1. 68	90			0.30 30. 3	150	qR				qR			rS	>V6	+	0	III

A transition through three stages was noted in these patients, who formed a minority of a larger series of prospective patients with chronic obstructive lung disease. The possible factors influencing the change in direction of the mean QRS vector in these patients are discussed.

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