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Medicine

STUDY OF CLINICAL PROFILE AND ELECTROCARDIOGRAPHIC CHANGES IN CHRONIC OBSTRUCTIVE PULMONARY DISEASE

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ABSTRACT

AIMS: To analyse the ECG changes in COPD patients and to correlate them with the severity of the disease.

MATERIAL AND METHODS: COPD patients were clinically examined and underwent chest radiograph, ECG, 2D Echo and spirometry

RESULTS: 82% were males and 18% were females. The mean duration of symptoms was 9.88±6.123 years. The mean FEV1 was 42.14±11.63 percentage of predicted. The most common at presentation was tachypnoea (88%) followed by loud P2 (46%).36% of patients had features suggestive of right heart failure. 24% of the patients had cyanosis and 10% of the patients had clubbing. The most common ECG abnormality is right axis deviation of P wave (64%) followed by right axis deviation of QRS complex (60%).

CONCLUSIONS: ECG is better than clinical methods in detecting right ventricular dysfunction in COPD.

KEYWORDS : Chronic Obstructive Pulmonary Disease ECG

INTRODUCTION

Chronic obstructive pulmonary disease (COPD) is an important cause of morbidity, mortality and health-care costs worldwide. It is a global health issue, with cigarette smoking being an important risk factor, other factors such as occupational hazards, exposure to indoor and outdoor air pollution, and infections are also important.

The major morbidity of COPD is due to its impact on the cardiac performance caused by pulmonary arterial hypertension. Lung function tests in particular FEV1, remains the reference marker for the diagnosis, assessment of severity and prognosis of COPD. ECG is a simple bedside investigation. Hence it would be of great importance, if a high degree of correlation between ECG changes and spirometric studies can be established, which indicate the severity of COPD. This study attempts to correlate the ECG changes with the severity of the disease as assessed by lung function tests.

AIMS OF THE STUDY

1. To analyse the clinical signs and symptoms of COPD patients.
2. To analyse the ECG changes in COPD patients and to correlate them with the severity of the disease.

METHODOLOGY

Patient admitted in Osmania General Hospital with the diagnosis of COPD whom met inclusion criteria were analysed clinically and underwent investigations like ECG, chest x ray and spirometry. Data was analysed using mean, standard deviation and Chi square test.

RESULTS

In the present study 50 patients with COPD who met the inclusion and exclusion criteria were randomly selected and the results of this study are as follows. In this study 82 %(41) were males and 18 %(9) were females.

The mean age of presentation in this study group is 66.86±7.29 years and range is 52 to 87 years. In this study maximum number of COPD patients are clustered in the age group of 60 to 79 years that is in the seventh and eighth decade (78%). Duration of the Disease: The mean duration of symptoms was 9.88±6.123 years, ranged between 2 and 25 years.Severity of the disease: The mean FEV1 was 42.14±11.63 percentage of predicted, ranged between 25 and 66 percent of predicted. Duration of tobacco use: The mean duration of tobacco use was 56.9 pack years with range from 24 to 110 pack years. Majority of the patients (64%) had history of tobacco exposure for more than 40 pack years. Correlation of tobacco exposure with disease severity: All patients in this study had history of more than 20 pack years of tobacco exposure. Majority of the patients with severe disease (i.e. 18/29 patients) and very severe disease (i.e. 4/7 patients) had history of more than 40 pack years of tobacco exposure. Symptoms at presentation: All patients in this study had history of cough with sputum production and breathlessness at presentation. 38% of the patients presented with swelling of the legs and 24% of the patients presented with symptoms suggestive of carbon dioxide narcosis like headache, drowsiness, lethargy. Physical signs at presentation: The most common at presentation was tachypnoea (88%) followed by loud P_2(46%). 36% of patients had features suggestive of right heart failure (elevated JVP, pedal oedema, tender hepatomegaly). 24% of the patients had cyanosis and 10% of the patients had clubbing.

Table 1: Frequency of occurrence of ECG changes

ECG abnormality	Number of cases	Percentage (%)
RAD of QRS complex	30	60
P pulmonale	21	42
RAD of P wave	32	64
R wave amplitude in V_5orV_6 <5 mm	14	28
R/S ratio in V_5or V_6 <1	12	24
RBBB	21	42
R wave amplitude in V_1>7mm	4	8
R/S ratio in V_1 >1	16	32
Others	5	10

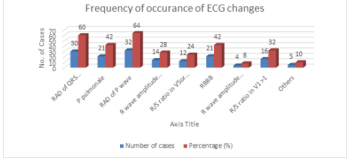

Table 2: Correlation of ECG findings with severity of the disease

ECG Findings	Moderate N=14		Severe N=29		Very severe N=7		X^2	p	Significance
	No	%	No	%	No	%			
RAD of P wave axis	8	57	22	75	2	28	6.79	0.045	S
R wave amplitude in V_5or V_6<5mm	0	0	12	41.3	2	28	11.58	0.003	HS
R/S ratio in V_5orV_6<1	0	0	10	34.5	2	28	9.369	0.009	HS
RBBB	6	42.8	14	48.2	1	14	2.998	0.223	NS
R wave amplitude in V_1>7mm	1	7	3	10.3	0	0	1.382	0.501	NS
R/S ratio in V_1>1	5	35.7	8	27.5	3	42.8	0.715	0.699	NS

S= significant, HS= highly significant, NS= Not significant.

Table 3: Correlation of ECG findings with duration of disease

ECG findings	1-9 yrs. N=26		10-19yrs N=19		>20yrs N= 5		X^2	p	S
	No.	%	No.	%	No.	%			
RAD of P wave axis	16	61.5	13	68.4	3	60	0.266	0.875	NS
R wave amplitude in V_5orV_6<5mm	5	19.2	5	26.3	4	80	6.934	0.031	S
R/S ratio in V_5orV_6<1	3	11.5	6	31.5	3	60	0.082	0.047	S
RBBB	11	42.3	8	42.1	2	40	0.009	0.995	NS
R amplitude in V_1>7mm	1	3.8	1	5.2	2	40	4.834	0.089	NS
R/S ratio in V_1>1	8	30.7	6	31.5	2	40	0.161	0.922	NS
RAD of QRS	4	15.3	10	38.4	3	60	8.762	0.015	S

In the present study R wave amplitude in V_5 or V^6 <5mm and R/S ratio in V_5 or V_6 <1 were found to significantly correlate with the duration of the disease. But other ECG parameters like right axis deviation of P wave, right bundle branch block, R wave amplitude in V_1>7 mm, R/S ratio in V_1>1 were not found to correlate with duration of the disease.

DISCUSSION

1. Sex distribution

The higher incidence of COPD in males can be attributed to higher incidence of smoking amongst men. In this study none of the women were smokers, but all of them had history of cooking with dried wood fuel and other biomass exposure.

Table 4: Comparison of sex distribution

Author and Year	Percentage of Males
V. K. Singh et al 1989 [38]	94.6
Chappell A. G. 1966 [20]	81.5
Present study	82

2. Age Distribution

The highest number of COPD patients (39/50) in this study was in the age group of 60 to 79 years with mean age 66.87(±7.21) years.

Table: 5: Comparison of age distribution

Authors and Year	Mean Age
1. Keller & Shepard et al, 1986 [39]	59±7 yrs
2. Putnik and Povazan, 1998 [40]	59.25 yrs
3. Present study	66.87(±7.21)

3. Duration of Symptoms

In this study most of the patients (26/50) gave history of symptoms of 1 to 9 years duration, with a mean duration of dyspnoea 7.013 ± 5.0439 and cough of 9.092±6.303years.

4. Severity of the disease

Table 6: Comparison of severity of the disease

FEV1	Higham et al [42], 1988	Present
	n(%)	n(%)
50-79%	12(16.4%)	14(28)
30-49%,	19(26%)	29(58)
< 30%	42(57.6%)	7(14)

Table 7: Comparison of mean FEV1 (SD)% of predicted

Study (Year)	Mean FEV_1(SD) (% of predicted)
Keller et al, (1986) [39]	33(14)
M.A. Higham et al [42]	39.4(19.7)
Present study	42.145(11.63)

5. Duration of tobacco use and correlation to severity of disease

In this study, majority of the patients (18/50) had a history of tobacco use, more than 40 pack years, with a mean of 56.9(±23.9) pack years. And according to BTS guidelines most patients with COPD have at least 20 pack years of smoking history49. Our finding correlates well with this study.

6. Symptoms at presentation

All patients had breathlessness and cough with expectoration at presentation.

7. Physical signs at presentation

Most of the patients in the present study had tachypnoea(44/50) at presentation. Most of them had signs of hyperinflation, and also diminished breath sounds with prolonged expiratory phase. Clinical signs of pulmonary hypertension were present in 46% (23/50) of the patients.

8. ECG findings

1. Right axis deviation of QRS

Right axis deviation of QRS was present in 60% (30/50) of the patients in the present study. According to Murphy & Hutcheson27, right axis deviation is one of the most reliable criteria of RVH, and is more common in patients with RVH secondary to COPD than in those with RVH secondary to congenital heart disease and has a specificity of 95%. Millard[25] concluded that in chronic pulmonary disease, the position of mean QRS axis provided a good indication of right ventricular hypertrophy as any other electrocardiographic sign. Our findings are in agreement with the above studies.

Table 8: Comparison of Right Axis Deviation of QRS

Author and Year	Incidence (%)
Milnor, 1957 [44]	18.75
Padmavathi and Pathak , 1959 [45]	74
Silver and Calatayud, 1971 [46]	19
Padmavathi and Raizada, 1972 [47]	43.2
Murphy and Hutcheson, 1974 [22]	28
Present study	60

1. R/S ratio in V1 > 1

Table 9: Comparison of R/S in V1 >1

Author and Year	Incidence (%)
Murphy & Hutcheson, 1974 22	7.5
Silver & Calatayud, 1971 46	7
Present study	32

3. R wave amplitude in V1 > 7mm

Table 10: Comparison of R wave amplitude in V1> 7 mm

Author and Year	Incidence (%)
Silver and Calatayud, 1971[46]	21
Padmavathi and Raizada, 1972[47]	2.6
Murphy & Hutcheson, 1974[22]	9.4
Present study	8

4. R/S ratio in V5or V6 < 1

Table 11: Comparison of R/S ratio in V5 or V6 <1

Author and Year	Incidence (%)
Silver and Calatayud, 1971[46]	21
Padmavathi & Raizada, 1972[47]	77.9
Murphy and Hutcheson, 1974[22]	23
Present study	24

5. Incomplete RBBB

Table 12: Comparison of Incomplete RBBB

Author and Year	Incidence (%)
Padmavathi and Raizada, 1972[47]	12.9
Murphy and Hutcheson, 1974 [22]	2
Present study	38

6. P-pulmonale

Table 13: Comparison of P pulmonale

Author and Year	Incidence (%)
A. G. Chappell, 1966[20]	10
Silver and Calatayud, 1970 [46]	46.2
Padmavathi & Raizada, 1972[47]	95
Murphy & Hutcheson, 1974 [22]	26.4
Present study	42

7. Right axis deviation of P wave.

In the present study 32/50 patients were found to be having right axis deviation of P wave (64%). In the study by R.L. Agarwal and Dinesh kumar41 64.3 % patients had normal P wave axis and 35.7% patients LAD or RAD or indeterminate axis while majority patients that is 97.8% patient in whom COPD was absent had normal P wave axis

8. Complete Right bundle branch block (RBBB)

In the present study, only two patients had evidence of complete RBBB (4%). Similarly in the study by Padmavathi and Raizada24 4 patients out of 544 patients had RBBB and Chappell[49] study had 2 cases out of 122 patients. Milnor (1957)12 is of the opinion that presence of RBBB is more commonly due to coronary disease than RVH is also found in persons without heart disease.

6. Arrhythmias

In this study only two patients had transient atrial fibrillation. In a study by Chappell[49] of 112 patients, one patient had atrial flutter and another had paroxysmal atrial fibrillation. Arrhythmias (usually transient and usually supraventricular) are common especially during acute exacerbations of the disease and disappear once hypoxia is corrected.

7. Others

One patient in our study had inverted T wave in V1 and V2. T wave is upright in V1 and V2 but of decreased amplitude, gets inverted in chronic cor pulmonale. One patient found to have qS in V1-4 and three patients had S1S2S3 syndrome in limb leads.S1S2S3 syndrome indicates extreme axis deviation that is northwest region[47]

11. Correlation of ECG findings with severity of the disease

In the present study no patients were found in the category of mild degree of COPD according GOLD criteria. Statistical analysis showed significant correlation between ECG findings like right axis deviation of P wave, R wave amplitude in V5 or V6<5mm and R/S ratio in V_5or V_6 <1 and severity of the disease. But ECG findings like RBBB, R wave amplitude in V_1>7mm and R/S ratio in V_1 >1 did not correlate with the severity of the disease.

Most of the patients in our study belonged to the category of severe degree (58%) of COPD according to GOLD criteria, followed by moderate degree (28%) of COPD. Caird and Wilcken (1962), observed that 'P' pulmonale and evidence of RVH are much more frequent when FEV1 falls below 45% of normal than above it. The likely explanation given by them is that a ventilatory capacity of < 45% of predicted is inadequate to maintain normal blood gases in the face of inequalities of ventilation and V/Q ratios and it has been repeatedly shown that pulmonary hypertension is correlated with degree of arterial oxygen desaturation and hypercapnea.

A. G. Chappell[20] studied 112 patients, dividing them into 2 groups, one with FEV1 < 1200 ml and other with > 1200 ml and found that, right ventricular hypertrophy, 'P' pulmonale and vertical 'P' axis occurred more frequently in patients with widespread emphysema than in the other group.

M. K. Tandon[21] also found increasing incidence of P-pulmonale, right axis deviation of QRS and dominant S in V_5 or V_6<1 with increasing severity of the disease as defined by FEV1/FVC ratio.

V.K. Singh and his coworkers[32] also found increasing incidence of 'P' pulmonale, R/S ratio in V_5 or V_6<1 , QRS axis > 90° and R wave amplitude inV_6 <5 mm, as the FEV_1 / FVC ratio was decreasing, which was statistically significant and explained that this trend was due to increased alveolar air trapping and blood gas derangement.

12. Correlation of ECG findings with duration of disease.

R wave amplitude in V_5 or V_6 <5mm, R/S ratio in V_5 or V_6 <1 and right axis deviation of QRS complex which are ECG signs of RVH, are found with increasing incidence as duration of disease increases.

CONCLUSIONS

The following conclusions can be drawn from this study

- COPD is more common in males and in the 6th and 7th decade.
- Most of the patients have fairly advanced disease at presentation.

ECG is better than clinical methods in detecting right ventricular dysfunction in COPD.

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