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THE CORRELATION OF PULMONARY FUNCTION TESTS AND E.C.G. IN PATIENTS WITH CHRONIC OBSTRUCTIVE LUNG DISEASES

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INTRODUCTION

Right ventricular hemodynamics vary at different stages in the evolution of COLD (Williams and Behnke. 1964; Burrowset al, 1972 and Fishman, 1980). Patients with mild COLD without severe hypoxemia generally have normal mean right atrial and left ventricular end-diastolic pressures, low to normal cardiac outputs, normal or slightly elevated pulmonary artery preessures and slightly elevated pulmonary vascular resistance at rest. At this Point, clinical or electrocardiographic evidence of right ventricular enlargement, is absent. However acute right ventricular failure can develop if respiratory-failure is precepitated by a pulmonary infection. As the obstructive ventilatory impairement worsens, the hemodynamic alterations also are accentuated, when severe chronic hypoxemia develops in association with chronic hypercapnia, there is moderate pulmonary hypertension at rest. These individuals are likely to show clinical and ECG changes ususlly ascribed to cor pulmonale. The degree of obstructive ventilatory impairment in patients with COLD, assessed by FEV was related to evidence of R.V. dysfunction and a similar relationsship was found between the severity of arterial hypoxemia and abnormal R.V. performance .Thus severe abnormalities in FEV and PaO 2 appear to be indirect indicators of augmented R.V. afterload in COLD. (Mothay and

Berger l981).

The aim of the present work is to findout the electrocardiographic changes and to correlate them to different parameters of lung function testing. This was done with the purpose of assessment of the value of such electrocardiographic changes in diagnosis and severity scoring of COLD. In other words, to findout which of these changes can scafollsd or substitute various parameters of lung function testing in diagnosis and assessment of COLD.

MATERIAL AND METHODS

The present study was conducted on 53-patients (18 females and 35 males with mean age of 47 +12.3) with chronic obstructive lung diseases, attending the outpatient clinic of chest diseases and inpatient of Mansoura University Hospitals. Cases .selected were not including patients with clinically demonstrable right sided heart failure and having chest diseases due to underlying heart disease, Tubereulosis or bronchiectiasis.

All Patients Underwent The Following:

* Thorough history taking.
* Thorough clinical examination.
* Investigations including :

A. Roentgenographic examination of chest and heart. plain XRay of chest postero-anterior and sometimes lateral views

B. Sputum examination, by Ziehl-Neelsen stain for detection of acid fast bacilli, to exclude tuberculous patients before doing pulmonary function testing.

C. For each patient a set of pulmonary function tests was performed after a light breakfast. In order to be fully cooperative, all patients were taught before hand how to do the tests.

The set of pulmonary function tests Performed for each patient included the following :

- Tidal volume (TV).
- The vital capacity (V. C.) and Forced vital Capacity (F.V.C.).

- The Forced Expiratory volume in one second (F.E.V_I) which was expressed in absolute value. as a percent of predicted (F.E.V1%) and as percent of F.V.C. (F.E.V1% F.V.C.).

- The Maximum Breathing Capacity (M.B.C.), which was expressed in absolute value and as a percent of predicted (M.B.C%). The M.B.C. was obtained indirectly by multiplying the F.E.VI by 35 (Crofton and Doug 1 as, 1981).

- The forced inspiratory volume (F. I. V.).

- The functional residual capacity (F. R. C.).

- The expiratory reserve,volume (E. R. V.).

- The residual volume (R.V.), expressed in bsolute values and as a percent of total lung capacity (R. V.% T. L. C.).

-The total lung capacity (T. L. C.).

The predicted values for F.E.VI and M.B.C. were measured from the patient age, sex, height and weight using special charts (Hunshaw and Marray, 1980). Every patiuent tested thrice, and the mean value was taken.

According to the P.E.V1% of predicted, the total number of cases (53) were divided into four subgroups (Q_1, Q_2, Q_3 & Q_4), using the National Tubercublosis

Association classification of C.O.L.D. (1963) :

F.E.V1% of Predicted	> 70	< 70	< 55	< 35
subgroup	Q_1	Q_2	Q_3	Q_4

D. A resting electrocardiogram was performed for each patient comprising the 12-conventional leads. The electrocardiographic measurements were analysed in accnrdance with the accepted standards.

Every E.C.G. was read by two observers to minimise observer error:

- P-pulmonale was considered when P-wave amplitude >2.5 mm in leads II or III or a VF, Wassorburger et al., 19 59)

- S_1 Q_2 aa defined by Murphy and Hutcheson (1974).

- S_1 S_2 S_3 syndrom.e, was diagnosed when R/S rstio was less than one in leads, I, II and III or S-wave in these leads exceeding the upper limits of normal as defined by Simonson (1961).

- Lead "I" sign, was defined with an isoelectric P-wave, Q.R.S-amplitude <1.5mm and T-wave amplitude < 0.5 mm (Fowler et al., 1965).

- Incomplete right bundle branch block (Incomplete R.B.B.B.), was diagnosed when there was an R.S.R. pattern in the right procrdial leads with a QRSduration of < 0.12 second,(Megahed and Fahmy, 1967).

- The criteria for diagnosis of right-ventricular hypertrophy of Gooduin and Abdin (1959), were applied. -Low-voltage QRS in limb leads and V5 and/or V6 as defined by Wasserburger et al., (1959).

- A QR Pattern in AVR as defined by Fadmavati and Raizada (1971).

- The eight electrcardiographic criteria defined byKamper et al , (1970), were applied on the present series for scoring the severity of C.O.L.D. in relation to the number of E.C.G. criteria).

RESULTS

The results were analysed according to the student "t" test and tabulated in tables (I) to (6) :

DISCUSSION

Electrocardiographic studies in COLD were done-by many authors, and specific ECG patterns were described. P-wave mean axis > 80 in the frontal plane may be present in COLD as mentioned by Littman (l960); Scott,

(1961) and Fowr et al., (1965). In the Present study, a p-wave mean axis of 55.8 + 23.5 was found in COLD, in contrast to above authors.

On the other hand, non-gignificant changes were found on comparing P-axis among different subgroups (Table. 2).

Perlman (1971) found vertical P-Wave among control patients without respiratory symptoms and concluded that they are not specific for chronic respiratory disease., Spodick et al., (1963) stated that, verticalisation of the P-axis as well as P-amplitude were associated with more impaired lung function. In this study, P-axis mean value in QI was 50.75 + 21.66, and in Q4 was 66.6 + 22.3, while P-amplitude in Q1 mean value was 1.2 + 0.49 and in Q4 it was 1.396 + o.66 which go hand in hand with that found by the Previous authors. P- wave duratior_ in COLD, might be expected to be normal (Calatayud et al.. 1970). In the present work a nonsignificant change in P-wave duration was noticed, on comparing different subgroups (Table. 2). So it can be concluded that comparative analysis of P-wave axis, amplitude and duration among different subgroups of the present study, revealed that they could not serve the purpose of severity scoring in COLD.

P-pulmonale was reported to be present in 13.9% of COLD by Spodick (1959), 15.5% by Caird and Willken (1962), 25% in severe emhysema and 5.7% in mild emphysema, by Chappell (1966) in 33.3% and, inconstant by Fowler et al., (1965) and 46.2% in series of, Calatayud et al., (1970).

Padmavati and Raizada found P-Pulmonale in 95% of their cases of severe COLD, and attributed this high result to the long follow-up and severe pulmonary disease. Incidene percentage of P-pulmonale in their study was 11.3% in total cases, though appearing at the lower end of the spectrum of discrepantly higher incidence % P-pulmonale as reported above, yet this could be explained on basis of case selection and variable number of patients included in each study. Calatayud et al., (1970) found P-pulmonale incidence of 37% in the least impaired QI and 55% in the severely impaired Q4. Results of this study, revealed that Ppulmonale incidence in Q1 was 8.3% and 33.3% in Q4 indicating a Parallelism between incidence% and the degree of severity of COLD. Though the percentages appeared lower than that reported by Calatayud et al., (1970), yet no conflict is present as regards the fact that, a more incidence of P-pulmonale is in parallelism with the severity of COLD.

The mechanism of P-wave changes in lung disease is not clear, and was attributed to hyperinflation of the chest which causes the heart to rotate clocwise and that it becomes more vertical, (Perlman et al., 1971).

QRS-mean axis >90 in the the frontal plane may be present in COLD (Kamper et al., 1970). Padmavati anq Raizada (1972) found QRS-axis >90 in 79% of their cases, while, Murphy and Hutcheson (1974) reported it in 42% of their series. In the present study, the incidence of QRS-axis> 90 was 11.3% in the total cases (Table.3) It was evident from Table (3) that incidence of QRS-axis>90, was increased as the advance in severity of lung function, being 8.3% in QI and 25% in Q4. However, comparative analysis of QRS-mean axis and duration among different subgroups, revealed a nons significant change. So it can be concluded that neither QRS axis nor its duration could serve in assessment of desree of severity in COLD, (Table.2).

QRS-mean axis <-30, in the frontal plane, may be present in COLD. It was found in 10% by Grant (1957) in 12.1% by clatayud et al., (1970) and in 4.2% by padmavati and Raizada (1972) .It was accounted for in part by a shift in electrical axis or a possible associating myocardial ischemia. In the present study, it was found to be present in 9.4% of total cases of COLD, which is nearly similar to the previous studies.

QRs-amplitude <5mm in limb leads and V5 and/or V6 described to be present in COLD by Littman, (1960) and Spodick et al., (I963). In This study it was found in 64.1% of cases of Cold, which means that, this ECG pattern is commonly encountered in COLD, (Table.3). The incidence of low-voltage in different subgroups did not reflect a parallelism with the degree of geverity of COLD. An overall impression of a higher incidence for low-voltage in QI and Q2 versus Q3 and Q4 (table.3) is apparently contradicting the concept that more air trapping is expected the more advanced the disease. Such heterogenicity could be explained by an increase of electromotive forces in a Irather dominant right ventricle, the more the advanced the disease, balancing the insulating effect of air trapping. In this study comparative analysis of Rv_I, RV_6, SV_I and SV_6 among different subgroups of COLD revealed no significant charges as regards RvI, SVI and SV6 but there was a significant decrease in RV6 in the severest impaired subgroup Q4 ($P < 0.025$) as shown in Table (2). This could be explained on basis of clockwise rotation of the heart,where a low-voltage R-wave of right ventricle could replace a high, -voltage R-wave of left ventricular origin which' is commonly' encountered in this.lead in absence of clockwise rotation of the heart.

R/S ratio above one in VI was found in emphysema by ,Myers et al., (1948). R/S ratio > 1 in VI is an ECG criterion of right ventricular dominance, however. comparative interpretation of this ratio in different subgroups of this study, did no support the previous concept and this can be explained by the relatively low number of cases and probable. subgroup overlapping (Table.3).

R/S ratio < 1 in V5 and /or V6 was found in 78% of cases of COLD by Svester and Rubin (1965), Silver;and Calatayud (I971) and Padmavati and Raizada (1972). In this study, it was found in 5.6% of total cages, one case in.QI and 2 cases in Q4. This ratio can offer a vague parallelism with severity scoring in COLD.

Right precordial T-wave inversion was found transiently in 23% of cases of COLD by Padmavati and Raizada (1972). In the present work, the incidence of right precordial T-wave inversion was 9.4%, and so this parameter did not serve in diagnosis or assessment of scoring in COLD, being far from validity due to low number of cases in this study.

A qR pattern in a VR was found in 45% of cases of Padmavati and Raizada (lg72) and in 37.7% in this study.

Incomplete right bundle branch block (RBBB) may be found in emphysema Mounsey et al., 1952 and Littman, 1960). In this study, incomplete RBBB was found in 7.5% of cases (Table.3). Thig table also revealed that a q R pattern signifying clockwige rotation did not present concordant with geverity scoring among different subgroups.

S_1Q_3 pattern, was reported by Murphy and Hutcheson (1974) to be present in 48% of their cases of COLD, with pathologically proven R.V.H. In this study, it was found in 18.8% of cases.

S_1 S_2 S_3 pattern was observed in the least number cases with COLD, but all had severe degree Kaamper et aL., 1970). It was found in 36% by Murphy and Hutcheson (1974) . In the present work, it was noticed in 7.5% of total cases and it did not serve in severity scoring in COLD.

Lead "I sign", was found by,Fowler et al., (1965) in cases of COLD. In this study, it was found in 13. 2% of total cases, but its incidence in Q4 was 33 . 3%, which was more than in QI (8.3%), as shown in Table (3)

Right ventricular hypertrophy pattern was reported to be present in 75% of cases with COLD by Padmavati and Raisada (1972). In this study, by adopting the criteria of R.V.H. of Goodwin and Abdin (1959), it was found in 15% of total cases This discrepancy may be attributed to the larger number of patientg, the long term follow-up and gevere pulmonary disease in the series of Padmavati and Raizada (1972).

Calatayud et al., (1970) attributed

These changes and patterns possibily could in a sense substitute some Pulomnary function tests when they are non-feasible or liable to vitiation in non-cooperative patients.

SUMMARY AND CONCLUSIONS

This study revealed that F.E.V1% and M.B.C.%are good indices of severity of lung function impairement in cases of chronic obstructive lung disease followed by F.E.VI/F.V.C., absolute F.E.VI and R.V./T.L.C. respectively. Mean while F.I.V. was found significantly changed and other tests are less sensitive indices.

Arterial 02% saturation and Pao2 were changed significantly with severity of lung function imPairement than paCo2.

PaO2 was found to correlate positively with F.E.V1% and M.B.C.% and negatively, with R.V.% T.L.C. while PaC02 was found to correlate positively with R.V./T.L.C. and arterial 02% saturation only correlated positivelY with VT. On the other hand PaC02 found Positively correlating with P-wave amplitude, Samplitude in V6 and Q-Tc interval.

Good positive correlation was found between P-wave duration and F.E.V1% of F.V.C. and between P-wave amplitude and R.V.% of T.L.C. while P-wave axis ghowed no correlation with anY of the pulmonary function tests or blood gases.

An over all conclusion is that some electrocardiographic changes and patterns could serve the purpose of diagnosis and severity scoring in cases with chronic obstructive lung disease. These changes and patterns possibly could in a sense substitute some pulmonary function tests when they are non-feagible or liable to vitiation in noncooperative patients.

Table (1) : Comparison of pulmonary function tests in different subgroups of COLD.

	TV VT <	M.R.C. %of pred	F.I.V. (L.)	RV % TLC	FEV_1 % absolute	FEV_1 % of pred	FEV_1 % of FVC	$paCO_2$ (mmHg)	$paCO_2$ (mmHg)	Arterial 02%sat
Ql M.	0.583	79.866	1.942	43.66	2.13	79.866	81.39	91.63	38.29	95.725
(12) S.D.	0.127	6.14	0.52	5.89	0.446	6.14	8.26	12.05	4.09	1.13
Q2 M.	0.558	61.83	1.95	48.06	1.983	61.83	73.82	77.76	41.72	93.54
(12) S.D.	0.067	3.896	0.51	7.8	0.289	3.896	7.72	9.8	5.65	1.85
P	Non	0.001	Non	Non	Non	0.001	0.05	0.01	Non	0.005
Q3 M.	0.526	44.72	2.01	53.86	1.23	44.72	66.36	82.26	43.6	93.05
(17) S.D.	0.106	4.51	0.842	7.43	0.28	4.51	9.64	9.84	5.175	2.43
P	Non	0.001	Non	0.001	0.001	0.001	0.001	0.05	0.01	0.001
Q4 M.	0.516	27.29	1.15	62.04	0.792	27.29	4.76	70.39	49.1	91.49
(12) S.D.	0.134	5.42	0.3	9.69	0.21	5.42	13.08	11.83	11.54	3.66
P	Non	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.01	0.001
Total M.	0.567	51.7	1.6	52.09	1.5	51.7	68.8	80.48	42.2	93.42
(53) S.D.	0.112	19.7	0.53	10.05	0.61	19.7	13.5	13.07	7.8	2.8

M. = Mean Value S.D. = standard deviation p = probability test

Non = Non = Nonsignificant.

the electrocardiographic alterations in COLD to either pulmonary or cardiovascular factors or both. The pulmonary factors include hyperinflation of the lungs which might increase insulation, depress the diaphragm, and cause the heart to assume a more vertical position and to rotate clockwise on its points of fixation at the great vessels. The possible vascular factors include anatomical narrowing of the pulmonary vascular bed and/or vagconstriction due to hypoxemia causing pulmonary hypertengion and overload of the right veentricle and the right atrium.

From the Previous discussion, low-voltage QRS in limb leads and V5 and/or V6, was unable to serve the purpose of severity scoring in COLD. Accordingly we carried out an evaluation for the other six ECG criteria of,Kamper et al., (1970) as regards their sensitivity in scoring the severity of COLD Totale (4). Among the 53-patientg studied in this work. 38. patients had none, while remaining 15-cases presented one or more criterion. Seven cases satisfied one criterion, two sati$ified three criteria and four cases satisfied 4criteria. So it was found that the geverity of COLD correlated with the increased number of ECG criteria, which agree with that reported by kamper et al., (1970). The number of patients presenting with more than one criterion in each of the subgroups was relatively small but the results tended to be highly specific for COLD. SI S2 S3 patterm was met in the least number of cases. and if combined with the criterion QRS-axis >90 the severest impainment in lung function was noted, which agree with that found by Kamper et al., (1970). R/S ratio > l in V6 was met in the severest subgroup Q4 (2 cases) only. The P-wave criteria, namely axis > 80 and P-amplitude >2.5mm. were encountered alone in QI and Q2, which means that these two parameters if each of them occured alone are not indicators of severely impaired lung function.

When the criterion, P-axis >80 in our study was used in coniunction with QRS -axis >90 or R/S in V6 <1, the accuracy of diagnosis and severe lung function impairment was found, coinciding with that found by kamper et al., (1970).

Wasserburger et al., (1959); Chappell (1966); Calatayud et al., (1970) and ,Chapman (1974) found a negative correlation of P-axis with FEVI. Carilli et al., (1973) found P-axis to correlate with FEV1% FVC (r- o.59) aand RV/TLC (r-o.46). In the present study no correlation was found between P-xis and FEV1% FVC, M.B.C.%, Rv% TLC, VT and F.I.V. which correspond to what was reported by Caird and wilcken (1962) and Megahed and FahmY (1967). Also, no correlation was found between P-axis and blood gases, (Table. 5-a).

No correlation was found between QRS-axis and pulmonary function tests and blood gase, in this study which is similar to that found by Megahed and FahmY (1967) and, Carilli et al., (I973).

Megahed and Fahmy (1967) found no correlation between Q-TC interval and pulmonary function. tests, while in this study Q-TC was found to Correlate positively with FEV1% and M.B.C.% (r-o.673) and PaCo2 (r-o.799), and no correlation with other parameters (Table 5.a).

R-amplitude in VI and V6. and S-amplitude in V6 were found not to correlate with Pulmonary function tests and blood gas studies, apart from, a positive correlation between S-amplitude in V6 and PaCo2 (r-o.614).

Combination of P-wave axis more than or equal to 80 and QRs axis more than or equal to 90 or R/S ratio in V6 less than or equal to one correlates with accuracy of diagnosis and severest impairment of lung function.

It was revealed that accuracy of diagnosis and severity scoring in chronic obstructive lung disease correlate with the increase in number of electrocardiographic criteria.

An over all conclusion is that some electrocardiographic changes and patterns could serve the purpose of diagnosis and severity scoring in cases with chronic obstructive lung disease.

These changes and patterns possibily could in a sense substitute some Pulomnary function tests when they are non-feasible or liable to vitiation in non-cooperative patients.

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Combination of P-wave axis more than or equal to 80 and QRs axis more than or equal to 90 or R/S ratio in V6 less than or equal to one correlates with accuracy of diagnosis and severest impairment of lung function.

It was revealed that accuracy of diagnosis and severity scoring in chronic obstructive lung disease correlate with the increase in number of electrocardiographic criteria.

An over all conclusion is that some electrocardiographic changes and patterns could serve the purpose of diagnosis and severity scoring in cases with chronic obstructive lung disease.

Table (2) : Comparison ofCardiographic function tests in Different subgroups of COLD

		P-axis (degrees)	p-durat. (Sec).	P-ampl 0 (mm)	Qrs-axis degrees	RRS-Duration (Sec.)	RV_1 (mm) 157	RV_6 (mm)	SV_1 (mm)	SV_6 (mm)	R-Tc (Sec)
QI	M.	50.75	0.092	1.2	31.92	0.08	2092	9.083	6.625	0.417	0.385
(12)	S. D.	21.66	0.013	0.49	33.4	0.017	4.55	2.87	4.15	1.156	0.026
Q2	M.	53.42	0.08	1.075	22.66	0.086	1.375	6.5	7.166	0.71	0.396
(12)	S. D.	30.7	0.008	0.44	46.7	0.0098	1.32	3.655	3.485	0.75	0.037
	P	Non	Non	Non	Non	Non	Non	Non	Non	Non	Non
Q3	M.	54.9	0.094	1.5	47.35	0.086	2.15	8.56	6.765	0.44	0.37
(17)	S. D.	18.63	0.017	0.49	38.52	0.026	2.08	4.93	3.23	0.58	0.047
	P	Non	Non	Non	Non	Non	Non	Non	Non	Non	Non
Q4	M.	66.6	0.083	1.81	44.5	0.075	1.4	5.875	7.29	1.083	0.368
(12)	S. D.	22.3	0.019	0.95	49.18	0.015	1.59	3.425	3.79	0.85	0.042
	P	Non	Non	Non	Non	Non	Non	0.025	Non	Non	Non
Total	M.	55.8	0.088	1.396	37.62	0.082	1.966	0.59	6.94	0.59	0.38
(53)	S. D.	23.5	0.016	0.66	42.02	0.0165	2.64	0.81	3.6	0.81	0.04

M. = Mean Value S. D. = standard deviation p =probability test

Non = Non = Nonsignificant.

Table (3) incidence percentage of other electrocardiographic finding s in different subgroups of C . O . L . D.

		P-pulmon 158	Low volt. in limb leads & V5 & V6 ≤ 5mm	R/S ≥ I in VI	R/S ≥ I in V6	Rt. precord T-Wave in-version	qR in VR	In Comp. R. B. B. B.	S_I Q 3 pattern	SI S2 S3 pattern	Lead "I" sign	R. V. H.	QRS-axis ≥ 90	QRS-axis ≤ - 30	P-axis ≥ 80
Q I	No.	I	9	2	-	1	3	1	2	1	1	2	1	1	1
12)	%	8.3 %	75 %	16.6 %	-	8.3 %	25 %	8.3%	16.6 %	8.3 %	8.3 %	16.6 %	8.3 %	8.3 %	8.3 %
Q2	No.	-	8	-	1	1	8	-	1	2	1	-	1	2	2
(12)	%	-	66.6 %	-	8.3 %	8.3 %	66.6 %	-	8.3 %	16.6 %	8.3%	-	8.3 %	16.6 %	16.6%
Q3	No .	I	8	3	-	1	3	3	3	-	1	3	1	1	1
(17)	%	5.9 %	47.2 %	17.6 %	-	5.9 %	17.6	17.6 %	17.6 %	-	5.9 %	17.6 %	5.9 %	5.9 %	5.9 %
Q4	No .	4	9	1	2	2	6	1	4	1	4	3	3	1	4
(12)	%	33.3 %	75 %	8.3 %	16.6 %	16.6 %	50 %	8.3 %	33.3 %	8.3 %	33.3 %	25 %	25.%	8.3 %	33.3 %
		6	34	6	3	5	20	5	10	4	7	8	6	5	8
Total No.															
(53)	%	11.3 %	64.1 %	11.3 %	5.6 %	9.4 %	37.7 %	9.4 %	18.8 %	7. 5 %	13.2 %	15 %	11.3	9.4 %	15 %

RBBB = Right bundle brenck block

R . v . H . = Right Ventricular hypertrophy

Table . 4 : The distribution of some electrocaraphic cirteria in the different subgroups of C. O . L . D .

Case NO .	$S_1 S_2 S_3$ Syndrome Pattern	P - axis ≥ 80	lead "I" sign	P - ampli - ≥ 2.5 mm	QRS - axis ≥ 90	Ris ratio in v 6 ≤ 1	No . of E . C . G criteria
(Q 4)							4
1-		+	+		+	+	4
10-		+	+	+	+		1
14-				+			3
18-		+	+	+			2
47-		+	+				4
48-	+			+	+	+	
(Q 3)							
12		+	+	+	+		4
(Q 2)							
9-		+					1
24-	+						1
33-	+						1
46-		+	+		+		3
(Q1)							
23-		+	+				2
42-				+			1
44-					+		1
52-	+						1

Table (5) : Correlation of pulmonary function tests and blood gases with electrocardiographic finding s in cases with C . O . L . D .

	P-axis	P-durat-ion	P-amp I	QRS-axis	R-amp. inv_I	R-amp. inV6	S-amp. in V I	S-amp. in V 6	Q-Tc interval
Tidal Vol.	r = - 0.044	+ 0.21	- 0.246	- 0.181	+ 0.13	+ 0.339	+ 0.27	- 0.113	+ 0.412
M . B . C . %	r = - 0.11	+ 0.33	- 0.219	- 0.141	+ 0.191	+ 0.276	- 0.056	- 0.193	+ 0.673
FEV_1 absolute	r = - 0.22	- 0.03	- 0.396	- 0.189	+ 0.321	+ 0.316	+ 0.039	- 0.072	+ 0.219
F.E. v_1 %	r = - 0.11	+ 0.33	- 0. 219	- 0.141	+ 0.191	+0.276	- 0.056	- 0.193	+ 0.673
F . E . V_1 % FVC	r = - 0.349	+ 0.792	- 0.245	- 0.188	+ 0.154	+0.456	+ 0.406	- 0.230	+ 0.055
RV% TLC	r = + 0.152	- 0.206	+ 0.699	+ 0.14	- 0.217	- 0.106	- 0.303	+ 0.332	- 0.105
F . I . V .	r = - 0.026	- 0.042	- 0.291	- 0.037	- 0.194	- 0.115	+ 0.015	+ 0.261	+ 0.196
PaO2	r = - 0.287	+ 0.227	- 0.221	- 0.022	+ 0.289	+ 0.432	- 0.087	- 0.91	- 0.004
PaCO2	r = +0.308	- 0.323	+ 0.765	+ 0.138	- 0.003	- 0.249	+ 0.001	+ 0.614	+ 0.799
Arterial 02 % sat	r = - 0.331	+ 0.249	+ 0.228	- 0.066	- 0.112	+ 0.102	+ 0.037	+0.053	+ 0.428

r = Correlation coefficient

Table. 6 : Correlation of pulmonary function tests and Blood gases in cases of C. O. L. D.

	PaO 2	PaCO 2	arterial O 2 % Sat
Tiadal Volume	r = + 0.406	- 0.220	+ 0.860
M. B . C . % Predicted	r = + 0.783	- 0.247	+ 0.067
F E V $_1$ absolute	r = + 0.43	- 0.450	+ 0.438
F E V $_1$ % Predicted	r = + 0.783	- 0.247	+0.067
F E V $_1$ % FVC	r = 0.317	+ 0.172	+ 0.284
RV & TLC	r = -O.589	+ 0.503	- 0.484
F.I. V.	r = + 0.315	- 0.3	+ 0.354

r = Correlation co - efficient .

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