RESEARCH ARTICLE

Relationship between Spirometry and Electrocardiogram Variables in Undergraduate Students of a Medical College in Northeast India

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Abstract

Introduction: Medicos must be physically fit before serving patients. Spirometer variables and electrocardiogram (ECG) parameters are essential markers of the health status of an individual. Our study aims at determining some spirometer variables and ECG parameters and to find whether there is any association between the two.

Materials and methods: Sample size is calculated as 160 using EpiTools software. Spirometric variables viz., forced vital capacity (FVC), forced expiratory volume in 1 second (FEV_1), peak expiratory flow rate (PEFR), and ECG parameters like R–R interval and QRS axis of the students were recorded. The response frequencies and descriptive statistics like mean and standard deviations were calculated. The *p*-value <0.05 was considered significant.

Results: Comparison of spirometric variables between left axis deviation (LAD) ($n = 5$), right axis deviation (RAD) ($n = 3$), and normal axis ($n = 152$) showed that FVC progressively increased from 2.50 ± 1 to 2.69 ± 0.77 to 2.85 ± 0.58 L from LAD to normal axis to RAD participants.

Conclusion: ECG is a useful screening test along with spirometry to assess the severity of chronic obstructive pulmonary disease (COPD) based on the FEV_1/FVC ratio and identify the risk groups to manage or prevent disease progression.

Keywords: Electrocardiogram, Forced expiratory volume in 1 second, Forced vital capacity, QRS axis, Spirometry.

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Introduction

Pulmonary function tests are a good indicator of health and survival rates.[1,2] Among different pulmonary function tests, forced vital capacity (FVC), forced expiratory volume in 1 second (FEV_1), and peak expiratory flow rate (PEFR) are important tests. The FEV1/FVC ratio less than 0.7 generally indicate the airflow obstruction.[3] Thus, pulmonary function tests play a significant role in the assessment, diagnosis, and quantification of pulmonary ventilatory disorders.[4] Spirometry is invaluable as a screening test of general respiratory health.

Resting heart rate and cardiac axis are basic parameters to assess the cardiac status of an individual. Pal et al. study reported that ECG abnormalities included P-Pulmonale, right axis deviation, right ventricular hypertrophy (RVH) and atrial fibrillation (AF) showed uniformly increasing trend with the severity of GOLD stages.[5] Therefore, resting electrocardiogram (ECG) is performed to promote awareness and determine factors affecting cardiac health.[6]

In this study, we calculated the pulmonary variables viz. FVC, FEV_1, PEFR, and electrocardiographic parameters such as resting heart rate and cardiac axis of undergraduate medical students to find whether any association exists between them.

Materials and Methods

The present study was done in the Department of Physiology, Jorhat Medical College. It was an institution-based cross-sectional observational study. The study population included undergraduate medicos of Jorhat Medical College. Simple random sampling was used. The sample size was calculated and rounded up to 160 by EpiTools software. The study included student volunteers aged 18–25 years who were nonsmokers and gave consent for the study. Ethical clearance was sought from the Institutional Ethics Committee (H), Jorhat Medical College, Jorhat.

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Procedure of Digital Spirometry

The digital spirometer used was Helios 401 Medspiror machine. The nose clip was placed, and the subject took a big deep breath of air and exhaled air forcefully into the tube, followed by an equally forceful blow-in. This completed one forceful inspiration and expiration. FVC, FEV_1, and PEFR values were recorded and saved for further analysis.

Procedure of Recording Electrocardiogram

Students lay supine. The paper speed for recording six limb lead ECG was 25 mm/second, with 10 mm/mV amplification. R–R interval and cardiac axis in six limb leads were measured. A female attendant was present for female students.

Statistical Analysis

MS Excel was used to calculate mean and standard deviations. The *p*-values were calculated by analysis of variance (ANOVA) test through interactive statistics software. The *p*-value <0.05 was considered significant.

Results

The mean FVC and FEV_1 of 160 students were 2.68 ± 0.78 and 2.29 ± 0.81 L, respectively, and the mean PEFR was 5.40 ± 1.63 L/second (Table 1).

Out of 160 participants, 95% had normal cardiac axis, 3 and 2% had left axis deviation (LAD) and right axis deviation (RAD), respectively (Figs 1 to 3).

The mean R–R interval of total 160 participants was 19.52 ± 3.66, the mean QRS axis was 54.93 ± 32.77°, and the mean heart rate of total 160 participants was 79.43 ± 14.22 beats/minute (Table 2).

Comparison of spirometric variables between LAD (*n* = 5), RAD (*n* = 3), and normal axis (*n* = 152) showed that FVC progressively increased from 2.50 ± 1 to 2.69 ± 0.77 to 2.85 ± 0.58 L from LAD to normal to RAD participants. FEV_1 also raised from 1.7 ± 0.79 to 2.33 ± 0.81 to 2.37 ± 0.39 L from LAD to normal to RAD participants. PEFR also increased from 4.71 ± 1.33 to 5.43 ± 1.61 to 5.93 ± 0.75 L from LAD to normal to RAD participants; however, not significant by ANOVA (*p*-value >0.05) (Table 3).

Fig. 1: Mouth transducer used for digital spirometry test

Table 1: Mean spirometric values among the study participants

Parameters	*Mean ± SD*
FVC (L)	2.68 ± 0.78
FEV_1 (L)	2.29 ± 0.81
PEFR (L/second)	5.40 ± 1.63

Table 2: Mean ECG variables among the study participants (*n* = 160)

Parameters	*Mean ± SD*
R–R interval	19.52 ± 3.66
QRS axis (in degrees)	54.93 ± 32.77
Heart rate (beats/minute)	79.43 ± 14.22

Discussion

In the present study, the mean FVC and FEV_1 of 160 students were 2.68 ± 0.78 and 2.29 ± 0.81 L, respectively, and mean PEFR was 5.40 ± 1.63 L/second. Another study consists of mean value of FEV_1 (1.12 ± 0.34), FVC (2.22 ± 0.50), which belong to moderate to severe airflow obstruction.[7] The reduction in mean FVC and FEV_1 values was also reported in previous studies conducted through digital spirometer.[6] This could possibly be due to the students being less accustomed to the digital spirometer maneuver for calculation of the dynamic lung functions like FVC, FEV_1, PEFR, as compared to the manual spirometer test taught in Physiology practical classes for calculation of the static lung functions (lung volumes and lung capacities) (Fig. 4).

In our study, the mean R–R interval of total 160 participants was 19.52 ± 3.66, mean QRS axis was 54.93 ± 32.77°, and mean heart rate of total 160 participants was 79.43 ± 14.22 beats/minute. Our

Fig. 2: From left to right: Mouth transducer, mouthpieces, nose clip, data cable used for digital spirometry

Fig. 3: From left to right: Charging cable, electrocardiograph machine, ECG jelly, roll paper used in the present study

Table 3: Comparison of spirometric variables between LAD (*n* = 5), RAD (*n* = 3), and normal axis (*n* = 152)

Parameters (mean ± SD)	*LAD (n = 5)*	*Normal (n = 152)*	*RAD (n = 3)*	*p-value*
FVC (L)	2.50 ± 1	2.69 ± 0.77	2.85 ± 0.58	0.8082
FEV_1 (L)	1.7 ± 0.79	2.33 ± 0.81	2.37 ± 0.39	0.2288
PEFR (L/second)	4.71 ± 1.33	5.43 ± 1.61	5.93 ± 0.75	0.5229

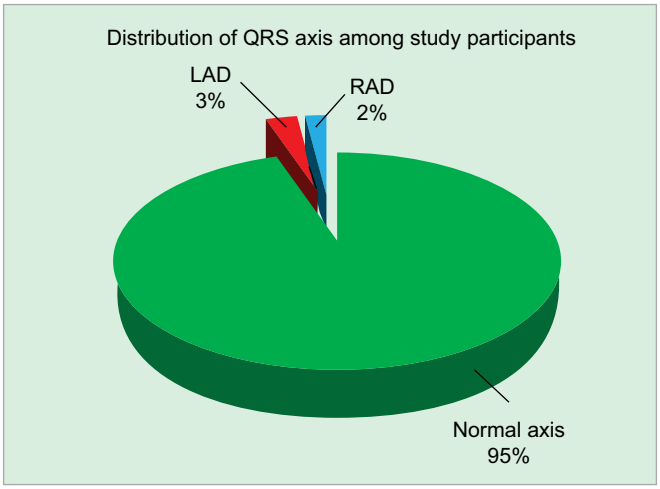

Fig. 4: Distribution of QRS axis among study participants

finding was similar to a previous study conducted by Padaki et al.,[8] where mean QRS axis came to be 56.5 ± 33.4°.[6] This could possibly be because majority of students belonged to normal weight (n = 93), and therefore the mean R–R interval, mean QRS axis, and mean heart rate of total 160 participants were reflected within normal range.

In our study, the FVC progressively increased from LAD to normal axis to RAD participants, that is, FEV_1/FVC ratio progressively decreased with increase in QRS axis. Similar to our study, there was a significant negative correlation between the FEV_1/FVC values and the incidence of various electrocardiographic features and showed similar correlation in the findings of Singh and Jain[9] study group. Another study by Tanwar et al.[10] found that RAD appeared to be the most common ECG finding in patients with COPD. Patients with advanced disease and longer disease duration have a high risk for ECG to be abnormal.[10]

Ruskin et al.[11] defined severity in terms of FEV_1 and residual volume and total lung capacity (RV/TLC) ratio. Of severe chronic obstructive pulmonary disease (COPD) patients, 66% had QRS axis in the 60–120° range, and only 40% of mild COPD had QRS axis in this range. Hypoxia is a major factor leading to ECG changes in COPD. Study by Kiani et al.[12] emphasize the importance of ECG as a non-invasive diagnostic tool for identifying cardiovascular complications in COPD patients. Diagnostic values of ECG among patients with respiratory problems suggest that COPD patients should be screened electrocardiographically in addition to other clinical investigations.[13,14]

Conclusion

We can conclude that ECG is a useful bedside screening test to assess the severity of COPD, and early preventive measures can be taken by doing spirometry (FEV_1/FVC ratio) and correlate and identify the risk groups.

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