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Original Article

Evaluation of spirometry findings with severity of coronary artery disease in smoker patients undergoing angiography in military hospital during 2019-2020

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Abstract: Background: Coronary heart disease is the most common cardiovascular worldwide, and some factors can affect the prognosis of this disease. So, in this study, we aimed to examine the relationship between spirometry and cardiovascular risk factors in patients undergoing coronary angiography who were referred to military hospitals. Methods: In this cross-sectional study, 200 smokers referred to military hospital for angiography, were enrolled in terms of the inclusion and exclusion criteria between 2019 and 2020. The severity of the coronary artery involvement was determined using Gensini score. The relationship among spirometry and the forced expiratory volume in one second (FEV1), forced vital capacity (FVC), and FEV1/FVC with other variables including lipid profile, demographic findings, blood pressure, physical activity, and severity of coronary artery involvement were also exanimated. Results: The frequency of severity of coronary involvement were reported as 3.5% with 25% involvement, 7% with 26-50% involvement, 5.5% with 51-75% involvement, 27.5% with 76-90% involvement, 47% with 91-99% involvement, and 9.5% with 100% involvement. In addition, there was no significant relationship between severity of coronary involvement and FEV1 and FVC ($P>0.05$). However, there was a significant difference between the groups based on FEV1/FVC ($P=0.003$), in which the mean of FEV1/FVC was significantly lower in higher severity of coronary involvement compared to lower severity of coronary involvement. There were significant relationships between severity of coronary involvement and body mass index, fasting blood sugar, high-density lipoprotein and low-density lipoprotein, cholesterol, triglyceride, waist circumference, systolic blood pressure, diastolic blood pressure, physical activity, and smoking ($P<0.05$). Conclusion: There is an association between pulmonary diseases and coronary disease, in which the increased coronary involvement severity is associated with the decreased FEV1/FVC.

Keywords: Coronary artery disease, pulmonary diseases, pulmonary function test

Introduction

Cardiovascular disease, especially coronary heart disease, is known as the main cause of death in developed and developing countries. Moreover, the coronary artery disease (CAD) is known as the deadliest cardiovascular disease, which has allocated more than 50 percent of cardiac death [1]. The prevalence of cardiovascular diseases is growing very quickly in developing countries, and it is expected to be the main causes of death in the coming decades [2]. Due to the high prevalence of cardiovascular and pulmonary diseases in recent years, following the mortality and disability resulted from these diseases as well as many characteristics of pulmonary and cardiac diseases that are similar and common and also often need the same treatments. In addition, the relationship between these diseases can contribute to their prevention, diagnosis, and treatment. Recently, some spirometry findings such as the forced expiratory volume in one second (FEV1), forced vital capacity (FVC), and FEV1/FVC have been linked with cardiovascular disease [3-10].

Although pulmonary diseases are common in patients with CAD but pulmonary function test is not suggested for all patients with CAD and spirometry is performed for 30% of patients with CAD and dyspepsia [11]. Spirometry is a primary diagnosis test for respiratory disorders

that is safe and simple and non-invasive method and also obstruction lung diseases are diagnosed with spirometry and non-need to other diagnosis methods [12, 13].

Notably, no studies have recently investigated how spirometry findings are in severe smoker patients under angiography and how it is associated with the severity of coronary artery involvement. Therefore, in this study, we aimed to examine the relationship between spirometry and cardiovascular risk factors in patients undergoing coronary angiography who were referred to military hospitals.

Materials and methods

Study design

In this cross-sectional study, which protocol of this study had adopted in the ethics Committee and the Medical University of the army, Tehran, Iran (Ethical code: IR.AJAUMS.REC1398.193). The smoker patients who had indication for angiography and referred to military hospital, Isfahan, Iran, were enrolled in terms of the inclusion and exclusion criteria. Accordingly, the inclusion criteria of the study included heavy smoker patients (over 30 pack/year) referred to the hospital for Angiography based on cardiologist opinion. Also the exclusion criteria were included patients with history of heart failure, myocardial infraction, replacement or stenosis or failure of valve, under investigation with coronary artery bypass surgery, percutaneous coronary intervention, and also patients with Pace makers. Also all patients had informed consent for participation to study.

Assessments of study

At the beginning of admission, a spirometry and echocardiography were requested for the patients. Demographical and clinical information of patients were included age, gender, lipid profile (triglyceride (TG), cholesterol (Chol), high-density lipoprotein (HDL) and low-density lipoprotein (LDL)), family history of cardiovascular disease, physical activity of the week, systolic and diastolic blood pressure, body mass index (BMI), waist circumference (WC), and fasting blood sugar (FBS). The severity of the coronary artery involvement was determined using Gensini score in angiography based on two cardiologist opinion. The correlations between spirometry profile (FEV1, FVC and FEV1/FVC) and other variables including lipid profile (HDL, LDL, Cholesterol, and TG), demographic findings, blood pressure, physical activity, and severity of coronary artery involvement were also evaluated.

Statistical analysis

Thereafter, quantitative data were shown as mean and standard deviation and qualitative data as frequency or percentage. Also, the data are displayed in chart and table formats as well. Afterward, the obtained data were entered into SPSS software version 24. Chi Square, Independent t test, and Mann-Whitney tests were used to analyze the data. $P<0.05$ was considered as the statistical significant level. Notably, one-way ANOVA test was used if necessary. In data analysis process, the confounding variables were analyzed and Mancova analysis was used for this purpose. After investigating the relationship between the studied indices with the severity of coronary artery involvement with univariance analysis in case of the significant level, the multi-variance analysis was performed, and finally in this analysis, the independent relationship of FEV1, FEV, and FEV1/FVC from cigarette smoking with the severity of coronary artery involvement was investigated.

Results

Primary variables

In this study, 200 patients including 177 men and 23 women with the mean age of 62.55± 7.76 years old were enrolled. Moreover, the means of BMI and waist circumference were 29.28±4.12 kg/m^2 108.21±11.90 cm, respectively. The means of lipid profiles, FBS, physical activity, pulmonary test findings, blood pressure, and smoking history are summarized in the **Table 1**. The frequency of severity of coronary involvement were reported as 3.5% with 25% involvement, 7% with 26-50% involvement, 5.5% with 51-75% involvement, 27.5% with 76-90% involvement, 47% with 91-99% involvement, and 9.5% with 100% involvement.

Results of experiment

There was no significant relationship between severity of coronary involvement and age and

Table 1. Variables of study in the patients

Variables		N=200
Gender	Male	177 (88.5%)
	Female	23 (11.5%)
Age (Mean ± SD) (year)		62.55±7.76
BMI (Mean ± SD) (Kg/m^2)		29.28±4.12
Waist circumference (Mean ± SD) (cm)		108.21±11.90
FBS (Mean ± SD) (mg/dL)		117.74±22.07
Cholesterol (Mean ± SD) (mg/dl)		209.36±47.80
TG (Mean ± SD) (mg/dl)		139.57±31.86
LDL (Mean ± SD) (mg/dl)		166.16±37.93
HDL (Mean ± SD) (mg/dl)		39.47±10.48
Physical Activity (Mean ± SD) (hours per week)		37.36±38.36
Smoking History (Mean ± SD) (pack/year)		43.51±8.79
FEV1 (Mean ± SD)		78.73±22.45
FVC (Mean ± SD)		84.94±24.36
FEV1/FVC (Mean ± SD)		76.20±9.89
SBP (mmHg)		132.61±13.72
DBP (mmHg)		81.38±11.01
Severity of coronary involvement	25%	7 (3.5%)
	26-50%	14 (7%)
	51-75%	11 (5.5%)
	76-90%	55 (27.5%)
	91-99%	94 (47%)
	100%	19 (9.5%)

BMI: Body mass index, FBS: fasting blood sugar, TG: triglyceride, LDL: low-density lipoprotein, HDL: high-density lipoprotein, FEV1: forced expiratory volume in one second, FVC: forced vital capacity, SBP: systolic blood pressure, DBP: diastolic blood pressure.

gender (P>0.05). In addition, there was no significant relationship between severity of coronary involvement and FEV1 and FVC (P>0.05). However, we found a significant difference between the groups based on FEV1/FVC (P= 0.003), in which the mean of FEV1/FVC was significantly lower in higher severity of coronary involvement compared to lower severity of coronary involvement. There were significant relationship between severity of coronary involvement and BMI, FBS, HDL, LDL, cholesterol, TG, WC, SBP, DBP, physical activity, and smoking (P<0.05) (**Table 2**). The severity of coronary involvement has increased along with the increase of FBS, BMI, TG, cholesterol, LDL, WC, and smoking history. Additionally, the severity of coronary involvement has decreased along with the increase of HDL and physical activity. In addition, SBP and DBP were similar to the other risk factors by having a direct relationship with severity of coronary involvement

Discussion

Based on our results, there is a significant relationship between coronary involvement severity and the decreased FEV1/FVC. In a review study conducted by Morgan et al. that investigated the prevalence and incidence of cardiovascular disease in patients with chronic obstructive pulmonary disease (COPD) as well as the mechanism of coronary artery involvement, it was concluded that the clinical characteristics of patients with COPD and cardiovascular disease (CVD) were very important to prevent of cardiovascular diseases in all ages and all stages of the COPD. Also, in patients over 65 years old with COPD, CVD diseases can be considered high risk. In addition, the risk of CVD diseases in COPD patients was increased in middle aged and elderly, so appropriate solutions should be performed for the prevention of these diseases [14]. In our study there was significant relationship between coronary involvement and pulmonary function test.

In a cohort study performed by Wang et al., they have examined the relationship between pulmonary function test and risk of cardiovascular disease, which concluded that the decrease of 5% of FEV1/FVC results was associated with increasing of 0.47% of cardiovascular disease risk within 10 years. Also, the increasing risk of cardiovascular disease was shown to be associated with a decrease in the amount of FEV1/FVC. Having COPD also was increased the risk of cardiovascular diseases up to 2.37. Therefore, in this study, it was found that reduction of pulmonary function can be associated with increasing risk of cardiovascular disease [15]. In the Cuttica's study, it was stated that lung function in young adults can be considered as an independent

Table 2. Relationship between variables of study and Severity of coronary involvement

Variables	Severity of coronary involvement	Mean	SD	*P* value*
Age (year)	25	60.42	10.11	0.15
	26-50	60.57	5.93	
	51-75	65.36	6.02	
	76-90	64.52	7.94	
	91-99	61.82	7.35	
	100	61.00	9.59	
BMI (kg/m^2)	25	22.57	3.40	<0.001
	26-50	24.57	.51	
	51-75	27.36	3.23	
	76-90	29.45	2.37	
	91-99	30.71	3.86	
	100	28.73	6.02	
FBS (mg/dl)	25	87.57	9.77	<0.001
	26-50	85.00	5.17	
	51-75	114.54	15.03	
	76-90	115.78	14.36	
	91-99	127.62	20.05	
	100	111.57	27.49	
FEV1	25	74.57	30.53	0.18
	26-50	65.83	23.41	
	51-75	71.00	23.67	
	76-90	83.60	25.54	
	91-99	78.95	20.51	
	100	79.47	14.55	
FVC	25	81.57	26.51	0.59
	26-50	76.25	34.03	
	51-75	78.88	20.48	
	76-90	88.91	27.31	
	91-99	84.35	21.15	
	100	87.82	24.67	
FEV/FVC	25	87.85	7.47	0.003
	26-50	79.69	11.96	
	51-75	77.63	13.32	
	76-90	75.70	10.01	
	91-99	75.98	8.58	
	100	70.94	8.75	
TG (mg/dl)	25	108.28	9.86	<0.001
	26-50	103.85	8.61	
	51-75	133.18	5.34	
	76-90	141.76	19.97	
	91-99	150.60	36.96	
	100	120.21	20.65	
LDL (mg/dl)	25	128.91	11.73	<0.001
	26-50	123.63	10.26	
	51-75	158.54	6.36	
	76-90	168.76	23.78	
	91-99	179.29	44.00	
	100	143.10	24.58	

HDL (mg/dl)	25	45.71	8.73	<0.001
	26-50	52.42	4.18	
	51-75	43.72	12.19	
	76-90	40.36	9.18	
	91-99	35.91	10.09	
	100	40.21	9.49	
Cholesterol (mg/dl)	25	162.42	14.79	<0.001
	26-50	155.78	12.92	
	51-75	199.77	8.01	
	76-90	212.64	29.96	
	91-99	225.90	55.44	
	100	180.31	30.98	
Waist circumference (cm)	25	102.42	7.25	0.002
	26-50	100.14	10.90	
	51-75	116.00	13.65	
	76-90	111.23	14.65	
	91-99	107.84	8.29	
	100	104.89	14.81	
SBP (mmHg)	25	121.28	7.11	<0.001
	26-50	113.57	7.18	
	51-75	149.54	24.54	
	76-90	134.90	11.32	
	91-99	133.47	11.15	
	100	130.10	11.51	
DBP (mmHg)	25	71.28	7.76	<0.001
	26-50	66.28	7.93	
	51-75	101.54	13.04	
	76-90	83.76	7.04	
	91-99	81.43	8.68	
	100	77.36	11.94	
Physical activity (hours per week)	25	152.28	6.04	<0.001
	26-50	81.35	23.36	
	51-75	73.27	5.19	
	76-90	39.29	4.08	
	91-99	12.58	8.18	
	100	58.78	65.72	
Smoking history (pack/year)	25	31.42	3.77	<0.001
	26-50	31.78	3.64	
	51-75	36.09	2.94	
	76-90	38.76	3.18	
	91-99	47.74	5.86	
	100	53.68	12.56	

BMI: Body mass index, FBS: fasting blood sugar, TG: triglyceride, LDL: low-density lipoprotein, HDL: high-density lipoprotein, FEV1: forced expiratory volume in one second, FVC: forced vital capacity, SBP: systolic blood pressure, DBP: diastolic blood pressure. *One-way ANOVA.

factor for developing cardiovascular diseases in middle age, which is associated with heart failure diseases and cardiovascular events, especially cardiovascular diseases [16]. Cardiovascular disease was associated with pulmonary disease in our results and also severity

of cardiovascular disease was increased with severity of disease.

In another study by Shibata et al. that was conducted on 3253 subjects, they have evaluated spirometry findings and their relationships with cardiovascular diseases in smoker patients. As a result, they showed that a lower level of FEV1 can be an independent risk factor for all-cause and cardiovascular mortality and also no significant relationship was observed between cardiovascular events and these findings [17]. In our study, there was significant relationship between FEV1/FVC and severity of coronary involvement and there was no significant relationship between FEV1 and coronary involvement.

Notably, these results are in line with the findings of our study. Another study conducted by Kaminsky et al. in 2010, evaluated 49 patients for their cardiac functions after angiography. They showed that changes in FEV1 are significantly correlated with changes in BMI only in patients with BMI >30 kg/m^2 [18]. There was no significant relationship between FEV1 and severity of coronary involvement. Furthermore, Engstrom et al. in their study evaluated 5064 subjects for their cardiac functions and spirometry tests were also performed. Accordingly, no significant correlation was observed between pulmonary test findings and severity of coronary arteries involvement [19]. These studies are not in line with the findings of our studies.

Our findings emphasized that pulmonary test findings are related to the severity of coronary arteries involvement. Jenkins et al. have evaluated 131 patients undergoing angiography and showed that the findings of spirometry are not fully correlated with involvement of coronary arteries. They have also evaluated the treatment methods of restoring lung functions in these patients and then reported that the usage of chest physiotherapy is one of the effective methods [20]. Furthermore, Lizak et al. compared spirometry findings of 3617 patients undergoing CABG with the involvement severity in their coronary arteries and reported that changes in FEV1 might be correlated with severity of coronary arteries involvements in non-smoker patients; however, there was a doubt about smoker patients. They suggested that more studies should be performed in this regard [21]. In addition, based on other study and our results, there is an association between pulmonary diseases and coronary disease, in which the increased coronary involvement severity is associated with the decreased FEV1/FVC. Moreover, there were relationships between severity of coronary disease and smoking, physical activity, blood pressure, and lipid profile. Future studies need to prove the relationship between pulmonary disease and coronary arteries involvement. Also, our limitation in this study was small sample size and limited studies performed in this subject.

Disclosure of conflict of interest

None.

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