ORIGINAL RESEARCH PAPER | Medical Science | Volume : 6 | Issue : 10 | October 2016 | ISSN - 2249-555X | IF : 3.919 | IC Value : 74.50

A Study on Pulmonary Function Tests in Metabolic Syndrome

KEYWORDS: Metabolic syndrome, pulmonary function tests, Forced expiratory volume in 1 second(Fev1),Low density lipoprotein cholesterol(LDL-C),Triglycerides,Waist circumference

Dr. U. Ramchander Rao	Dr. K.S. Amaravathi	T. Abhilash
Associate Professor, Department of General Medicine, Osmania General Hospital, Hyderabad, Telangana., * Corresponding Author	Assistant Professor, Department of General Medicine, Osmania General Hospital, Hyderabad, Telangana.	Senior Resident, Department of General Medicine, Osmania General Hospital, Hyderabad, Telangana.

ABSTRACT ***Background & Objectives***

In a number of recent studies, it was reported that among the changes in pulmonary function, pulmonary function, deterioration is related to hypertension, type 2 diabetes, low-density lipoprotein cholesterol, overall obesity, abdominal obesity and insulin resistance1. Among the above listed factors, hypertension, diabetes, and abdominal obesity are included as diagnostic criteria for metabolic syndrome, hence it can be inferred that identifying the relationship between metabolic syndrome and pulmonary function deterioration is meaningful. This study aimed to analyse various components of metabolic syndrome and its influence on pulmonary function tests.

Materials & Methods

This is a observational study, conducted on 132 patients in Osmania general hospital, Hyderabad.

Inclusion criteria: Persons fitting into criteria of Metabolic syndrome based on the Asia criteria of the American Heart Association/National Heart, Lung, and Blood Institute.

Exclusion criteria: Clinical history on cardiovascular disease (myocardial infarct, angina pectoris) and pulmonary disease (asthma, chronic obstructive pulmonary disease) or cancer, were excluded.

Results :

In this study, total number of subjects is n=132.The number of persons in metabolic syndrome group n=65, number of persons in control group n=67. In both groups majority had normal pulmonary function tests(n=26 in metabolic syndrome, n=61 in control group). In metabolic syndrome group, most common abnormality reported was mild restriction(n=26). The pattern of pulmonary function tests is mild restriction in metabolic syndrome subjects with a $p < 0.0001$ according to chi square test .In the overall study group, hypertension, fasting glucose, body mass index, waist circumference have significant negative correlation with both FEv1 and FVC (especially fasting blood glucose, Waist circumference, Body mass index with $p < 0.0001$) and triglycerides have significant negative correlation with FVC whereas total cholesterol has significant negative correlation with Fev1.Only HDL-c has strong positive correlation with FVC ($p < 0.0001$).The strongest negative predictors for FVC are Body mass index, Waist circumference, Fasting blood glucose in this study and the strongest positive predictor for FVC is HDL-c ($p < 0.001$)

Conclusion : *The findings in this study highlight the notion that FVC and FEV1 are inversely associated with the accumulation of metabolic syndrome components and also independently associated with each component of metabolic syndrome.*

INTRODUCTION :

Metabolic syndrome is a cluster of cardiometabolic risk factors characterized by abdominal obesity, insulin resistance, and chronic systemic inflammation.[2] Positive associations with lung function impairment have been reported for components of the metabolic syndrome, such as hypertension[3], type diabetes mellitus[4,5] ,low-density lipoprotein cholesterol[6], and overall obesity.[7]In recent large cohort studies, it has been shown that there is also a relationship between lung function impairment and the metabolic syndrome.[8]As the obese population increases, the incidence of metabolic syndrome is also increasing. There has been a recent report [9] on the relationship between the diagnostic criteria of metabolic syndrome or changes in the pulmonary function and cardiovascular mortality and total mortality. As such, there is increasing interest in changes in metabolic syndrome associated with changes in pulmonary function.

METHODOLOGY :

A total of 132 subjects are included. n=65 subjects fit into metabolic syndrome and others are included in control group. .

Inclusion criteria: Persons fitting into criteria of Metabolic syndrome based on the Asia criteria of the American Heart Association/National Heart, Lung, and Blood Institute.

Exclusion criteria: Clinical history on cardiovascular disease (myocardial infarct, angina pectoris) and pulmonary disease (asthma, chronic obstructive pulmonary disease) or cancer, were excluded. After a detailed history and physical examination, subjects underwent investigations like fasting lipid profile, fasting blood sugars, electrocardiogram, chest x-ray, pulmonary function tests, 2D echocardiography {if necessary}

STATISTICAL ANALYSIS :

Subjects' characteristics are summarized as mean and S.D. for continuous variables and frequency and percentage for categorical variables. Spearman rank correlation coefficients are estimated between the study variables and potential confounders including BMI, waist circumference, triglycerides levels, HDL-C levels, blood pressure, and fasting glucose levels.

RESULTS:

Majority of the subjects belonged to age group between

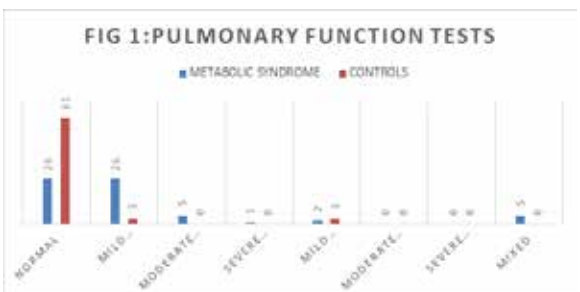
Volume : 6 | Issue : 10 | October 2016 | ISSN - 2249-555X | IF : 3.919 | IC Value : 74.50

51 -60(n=26 in metabolic syndrome group and n= 21 in control groups).There was a male preponderance in this study group (n=43(66%) in metabolic syndrome group and n=50(75%)in control groups). The number of smokers in metabolic syndrome group is n=39(60%) and number of smokers in control group is n=49(73%).The number of alcoholics in metabolic syndrome group is n=18(27.7%) and in control group is n=27(40.3%).Systolic blood pressure in most of the patients belonging to metabolic syndrome group measured in between 140-159 mm Hg(n=31) and in control groups between 120-139 mm Hg(n=32). Diastolic blood pressure in most of the patients belonging to metabolic syndrome group measured in between 90-99 mm Hg(n=24) followed by 80-89mm Hg(n=23) and in control groups between 80-89 mm Hg(n=28) followed by 60-79mm Hg(n=27).Majority of the persons in metabolic syndrome group are obese(27.5-29.9)(n=21)and in control group are overweight (23-24.9)(n=31).Majority of male persons in metabolic syndrome group the measured waist circumference is between 101-110cms(n=15).In majority of female persons with metabolic syndrome, the measured waist circumference is between 81-90 cms (n=12). ,In majority of male persons in control group the measured waist circumference is between 81-90cms(n=38).In female persons with metabolic syndrome, the measured waist circumference is between 71-80 cms (n=7).Majority of persons in metabolic syndrome measured fasting blood sugars is between 150-199mg/dL (n=22) and in control group is <100 mg/dL(n=46).Majority of persons belonging to metabolic syndrome group the measured total cholesterol is between 150-199mg/dL,200-249mg/dL (n=27 in both clsuters) and in controls it is in 150-199 mg/dL(n=32).Majority of persons in metabolic syndrome and control groups, the measured triglycerides fell in the range of 100-149 mg/dL (n=25 and n=48 respectively).Majority of persons in metabolic syndrome group, the measured HDL-c fell in the range of 30-39 mg/dL (n=45) and in control group in between 40-49 mg/dL(n=27).Majority of persons in metabolic syndrome group, the measured LDL-c fell in <100 mg/dL (n=36) and in control group in between 100-149 mg/dL(n=30). The mean parameters in both groups are shown in table 1.

TABLE 1: Baseline parameters of the persons in both metabolic syndrome group and control group.

PARAMETERS	METABOLIC SYNDROME GROUP	CONTROL GROUP	P VALUE
Age(years)	59.74 +/- 10.9	58.5 +/- 11.2	0.61
Male	43(66%)	50(75%)	0.34
Female	22(34%)	17(25%)	0.34
Systolic BP(mm Hg)	143.6 +/- 23.2	126.1 +/- 18.7	<0.00001
Diastolic BP(mm Hg)	88.7 +/- 10.5	80.6 +/- 11.3	0.0004
BMI(kg/m2)	27.9 +/- 2.5	23.8 +/- 1.4	<0.0001
Waist circumference(cms)	94.1 +/- 7.6	85.2 +/- 6	0.22
Fasting Blood sugar(mg/dL)	165.4 +/- 56.7	104.6 +/- 32.4	<0.0001
Total cholesterol(mg/dL)	196.1 +/- 34.7	177.9 +/- 38.9	0.99
Triglycerides(mg/dL)	150.6 +/- 48.4	131.1 +/- 26.2	0.99
HDL-c(mg/dL)	32.6 +/- 5.3	43.2 +/- 10	<0.0001
LDL-c(mg/dL)	95.1 +/- 40.2	115.1 +/- 33.8	0.99
SMOKERS	39(60%)	49(73%)	0.14 ; RR:0.75
ALCOHOLICS	18(27.7%)	27(40.3%)	0.14 ;RR:0.7
Fev1%	87.6 +/- 16	94.5 +/- 5.6	0.99
FVC%	78.6 +/- 14.2	90.9 +/- 5.8	0.17
Fev1/FVC %	101.3 +/- 14.3	101.7 +/- 11.5	0.39

In this study, in both groups majority had normal pulmonary function tests (n=26 in metabolic syndrome, n=61 in control group).In metabolic syndrome group, most common abnormal pulmonary function test reported was mild restriction (n=26) as shown in figure 1.



The correlations between metabolic parameters and PFTs observed in subjects affected by MS are shown in Table 2. Overall, HDL-C is negatively associated with FEV1%, whereas fasting glucose and HDL-C are negatively associated with FEV1/FVC%. The pattern of pulmonary function tests is mild restriction in metabolic syndrome subjects with a $p < 0.0001$ according to chi square test.

Table 2: Relationships between metabolic parameters and PFTs observed in subjects affected by metabolic syndrome(n=65). Spearman's Rank correlations are indicated.

Parameters	Fev1%	FVC%	FEV1/FVC%
Systolic Blood pressure(mm Hg)	Rho = - 0.12	Rho = 0.2	Rho = 0.4
	P = 0.35	P = 0.13	P = 0.73
Diastolic Blood pressure(mm Hg)	Rho = - 0.11	Rho = 0.14	Rho=0.02
	P = 0.4	P = 0.25	P = 0.9
Fasting glucose(mg/dl)	Rho = - 0.2	Rho = 0.001	Rho = - 0.25
	P = 0.11	P = 0.99	P = 0.04
BMI(kg/m^2)	Rho = 0.28	Rho = -0.13	Rho = 0.26
	P = 0.3	P = 0.3	P = 0.03

Volume : 6 | Issue : 10 | October 2016 | ISSN - 2249-555X | IF : 3.919 | IC Value : 74.50

Waist circumference(cms)	Rho = 0.14	Rho = - 0.22	Rho = 0.08
	P = 0.26	P = 0.08	P = 0.53
Triglycerides(mg/dl)	Rho = 0.01	Rho = - 0.17	Rho = 0.1
	P = 0.95	P = 0.18	P = 0.4
HDL-c(mg/dl)	Rho = - 0.24	Rho = 0.025	Rho = - 0.35
	P = 0.049	P = 0.84	P = 0.005
Total cholesterol(mg/dl)	Rho = - 0.05	Rho = 0.03	Rho = - 0.22
	P = 0.7	P =0.8	P = 0.08
LDL-c(mg/dl)	Rho = - 0.05	Rho = - 0.11	Rho = 0.11
	P = 0.67	P = 0.38	P = 0.36

DISCUSSION:

The findings of this study fits well with the recent documentation that the prevalence of MS is independently associated with restrictive lung impairment. A cross-sectional study of 159 consecutive nondiabetic elderly persons attending two social centres showed that restrictive, but not obstructive, respiratory pattern was associated with MS, at least in older people, and did not only reflect a limitation of ventilation due to visceral obesity.[10]

In fact, restriction was an independent correlate of MS, also after adjustment for waist circumference and body mass index (BMI). Lin et al.[1] demonstrated an association between MS and restrictive lung impairment also after adjustment for age, gender, BMI, smoking, alcohol drinking, and physical activity. Recently, Nakajima et al [11] confirmed that impaired restrictive pulmonary function might be associated with metabolic disorders and MS and documented a severity dependent association in an apparently healthy population. Obesity has been shown to be inversely related to lung function.[12-14] Fasting serum insulin levels are negatively correlated with FVC and FEV1. Furthermore, insulin resistance assessed by HOMA and prevalence of T2D are inversely associated with FEV1 and FVC.[15] Actually, in this study patients, abdominal circumference and also fasting blood glucose are retained as independent predictors of both FEV1 and FVC.HDL-C was the strongest predictor of FVC, with a positive association that has been observed both in smokers and in non-smokers. The mechanisms underlying this association are unknown. In any case, based on this reported data, the presence of lung function impairment itself is not clearly demonstrated as the changes in lung function possibly reflect changes in thoracic and abdominal wall compliance. Only two cross-sectional population-based studies conducted in Asians[1,11], have assessed the relationship between lung function impairment and metabolic syndrome. In accordance with this study findings, both reported metabolic syndrome to be significantly associated with the restrictive ventilator pattern, but not with the obstructive pattern. A similar finding was obtained in a small study of elderly patients by Fimognari et al.[10] However, in these previous studies, the association between lung function impairment and each individual component of the syndrome was not tested independently of the others. This study did not aim to determine whether insulin resistance or abdominal obesity was the driving force behind metabolic syndrome. Each component of metabolic syndrome may have a different influence on pulmonary function across racial groups. In an Italian study, HDL-C was the main predictor for pulmonary function impairment.[16]In a Japanese study, this relationship between lung function impairment and metabolic syndrome was thought to be due mainly to abdominal obesity and hyperglycemia in males.[17]In a Korean study, abdominal obesity, blood pressure, HDL-C, and fasting plasma glucose strongly influenced pulmonary function.[18]In an Australian study, poorer pulmonary function was also noted as metabolic syndrome components accumulated.[19] This study observed that the abdominal obesity component was strongly and inversely related to restrictive ventilator patterns, suggesting a role for mechanisms unrelated to lung volumes. WC is correlated with both subcutaneous adipose tissue and intraabdominal adipose tissue, but it is a better predictor of intraabdominal adipose tissue (deleterious fat deposition) than BMI.[20]

CONCLUSION :

In this study significant number of persons with metabolic syndrome had mild restrictive pattern of pulmonary function tests even though they were asymptomatic. More importance is to be given to lifestyle modifications like exercise, diet to decrease the incidence of metabolic syndrome.Prospective studies are needed, to determine the temporal relationship between lung function impairment and metabolic syndrome, including abdominal adiposity in particular.

LIMITATIONS OF THIS STUDY :

It was a small study population. Level of physical activity was not taken into consideration. Smoking status and severity of smoking are not taken into consideration. Restriction on spirometry is not confirmed with TLC as it is not available at our institution. The cross-sectional design of this study precluded the drawing of conclusions about the temporal relationship between lung function impairment and metabolic syndrome.

CONFLICTS OF INTERESTS : None

REFERENCES:

1. Lin WY, Yao CA, Wang HC, Huang KC. Impaired lung function is associated with obesity and metabolic syndrome in adults. Obesity (Silver Spring) 2006;14:1654–1661.
2. Grundy SM, Cleeman JI, Daniels SR, et al. Diagnosis and management of the metabolic syndrome: an American Heart Association/National Heart, Lung, and Blood Institute Scientific Statement. Circulation. 2005 Oct 25. 112(17):2735-52.
3. Selby JV, Friedman GD, Quesenberry CP., Jr. Precursors of essential hypertension: pulmonary function, heart rate, uric acid, serum cholesterol, and other serum chemistries. The American Journal of Epidemiology. 1990;131(6):1017–1027.
4. Ford ES, ManninoDM. Prospective association between lung function and the incidence of diabetes: findings from the national health and nutrition examination survey epidemiologic follow-up study. Diabetes Care. 2004;27(12):2966–2970.
5. Yeh HC, Punjabi NM, Wang NY, et al. Cross-sectional and prospective study of lung function in adults with type 2 diabetes: the atherosclerosis risk in communities (ARIC) study. Diabetes Care. 2008;31(4):741–746.
6. Cirillo DJ, Agrawal Y, Cassano PA. Lipids and pulmonary function in the third national health and nutrition examination survey. The American Journal of Epidemiology. 2002;155(9):842–848.
7. Bottai M, Pistelli F, di Pede F, et al. Longitudinal changes of body mass index, spirometry and diffusion in a general population. European Respiratory Journal. 2002;20(3):665–673.
8. Leone N, Courbon D, Thomas F, et al. Lung function impairment and metabolic syndrome the critical role of abdominal obesity. American Journal of Respiratory and Critical Care Medicine. 2009;179(6):509–516.
9. Sin DD, Wu L, Man SF. The relationship between reduced lung function and cardiovascular mortality: a population-based study and a systematic review of the literature. Chest. 2005;127:1952–1959.
10. Fimognari FL, Pasqualetti P, Moro L, Franco A, Piccirillo G, et al. (2007) The association between metabolic syndrome and restrictive ventilatory dysfunction in older persons. J Gerontol A BiolSci Med Sci 62: 760–765.

Volume : 6 | Issue : 10 | October 2016 | ISSN - 2249-555X | IF : 3.919 | IC Value : 74.50

11. Nakajima K, Kubouchi Y, Muneyuki T, Ebata M, Eguchi S, MunakataH. A possible association between suspected restrictive pattern as assessed by ordinary pulmonary function test and the metabolic syndrome. Chest2008;134:712–718.
12. Kannel WB, Cupples LA, Ramaswami R, Stokes 3rd J, KregerBE,Higgins M. Regional obesity and risk of cardiovascular disease;the Framingham Study. J ClinEpidemiol 1991;44:183e90.
13. Lazarus R, Sparrow D, Weiss ST (1998) Baseline ventilatory function predicts the development of higher levels of fasting insulin and fasting insulin resistance index: the Normative Aging Study. EurRespir J 12: 641–645.
14. Canoy D, Luben R, Welch A, et al. Abdominal obesity and respiratory function in men and women in the EPIC-Norfolk Study, United Kingdom. Am J Epidemiol 2004;159:1140e9.
15. Lawlor DA, Ebrahim S, Smith GD. Associations of measures of lung function with insulin resistance and type 2 diabetes:findings from the British Womens Heart And Health Study.Diabetologia 2004;47:195e203.
16. Rogliani P, Curradi G, Mura M, Lauro D, Federici M, et al. (2010) Metabolic syndrome and risk of pulmonary involvement. Respir Med 104: 47–51.
17. Yoshimura C, Oga T, Chin K, Takegami M, Takahashi K, et al. (2012) Relationships of decreased lung function with metabolic syndrome and obstructive sleep apnea in Japanese males. Intern Med 51: 2291–2297.
18. Choi JH, Park S, Shin YH, Kim MY, Lee YJ (2011) Sex differences in the relationship between metabolic syndrome and pulmonary function: the 2007Korean National Health and Nutrition Examination Survey. Endocr J 58: 459–465.
19. Yu D, Simmons D (2014) Association between lung capacity measurements and abnormal glucose metabolism: findings from the Crossroads study. Diabet Med 31: 595–599.
20. Klein S, Allison DB, Heymsfield SB, Kelley DE, Leibel RL, NonasC,Kahn R. Waist circumference and cardiometabolic risk: a consensus statement from shaping America's health: Association for Weight Management and Obesity Prevention; NAASO, the Obesity Society;the American Society for Nutrition; and the American Diabetes Association. Diabetes Care 2007;30:1647–1652.