Original Research Paper

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General Medicine

PULMONARY FUNCTIONTEST IN METABOLIC SYNDROME

Joshi R W

Bhangare Sayali* *Corresponding Author

Thomare Ganesh

Motlag M D

Pandharipande M S

Joshi P P

KEYWORDS :

Metabolic syndrome (MS) is a complex disorder recognized clinically by the findings of abdominal obesity, elevated triglycerides, atherogenic dyslipidaemia, elevated blood pressure, and high blood glucose and/or insulin resistance(1). It is associated with a pro-thrombotic and a pro-inflammatory state(2). Development of ventilatory dysfunction following particulate exposure is a major health concern worldwide. The interaction of these two disorders is a topic of considerable importance and debate.

Lung function impairment and metabolic syndrome have been associated with increased risk of cardiovascular diseases. However, data on the relationship between lung function impairment and metabolic syndrome are sparse. There is increasing evidence that impaired lung function is more than a simple reflection of airflow imitation; it may also be a marker of premature death. Several large prospective studies have shown that lung function impairment was predictive of increased cardiovascular morbidity and mortality, independent of smoking(1)(2).

Positive associations with lung function impairment have been reported for major cardiovascular risk factors, such as hypertension, type II diabetes mellitus, low density lipoprotein cholesterol, and overall obesity. Impaired lung function has also been shown to be predictive of atherosclerosis and arterial stiffening, suggestive of parallel remodeling in the lung and the large arteries. Inflammation is a key feature of metabolic syndrome. (3) A growing body of evidence suggests that individuals in the community with moderate airflow limitation may have co-existing systemic inflammation(4).

The mechanisms underlying the relationship between impaired lung function and cardiovascular risk are unclear.(4) With this background, we investigated a population of patients with metabolic disorder for the concomitant presence of pulmonary involvement assessed by ordinary pulmonary function tests (PFTs).

METHODS

The present study was conducted in a tertiary care hospital during the period of october 2015 to October 2017 at Indira Gandhi Government Medical College, Nagpur. It was a hospital based Case control study .Patients coming to Medicine outpatient department of tertiary care centre Indira Gandhi Govt Medical College who satisfy the elibility criteria were enrolled in the study.

In this study total 200 patients were included.

Total 100 patients for cases and controls each After fulfilling eligibility criteria cases were enrolled in the study. A diagnosis of metabolic syndrome will be made according to NCEP ATP III 2003 guideline. PFT will be performed using hand held spirometer.

The eligible patients were administered an informed consent. The consented participants were enrolled in the present study.

- Blood pressure was measured using mercury sphygmomanometer in right arm supine position to the nearest of 2 mmHg. Adequate cuff size ensured.

Patients were rested for 5 minutes before measurement. Systolic Blood pressure was determined when the sound appears in the beginning when mercury column is lowered down (korotkoff's phase) Diastolic Blood pressure was recorded at the level when the sound just disappears (korotkoff's phase).

Three readings were taken 5 minutes apart and mean considered as blood pressure. Standing blood pressure was taken after patient remains standing for 3 minutes and blood pressure recorded in standing position.

- Weight and height were measured using a daily calibrated digital scale and stadimeter with subject wearing light clothing and no shoes and body mass indexmju+-9(BMI) was also calculated by using Quetletindex (MacKay, 2010) (weight/height2- kg/m2).
- Waist circumference (WC)(5)Waist circumference was measured to the nearest 0.1cm using a non stretchable tape measure. Measurement was done

over the unclothed abdomen at the smallest circumference midway Material and Methods between the costal margin and the iliac crest. The tape was kept horizontal, with the subject relaxed with the arms held loosely by the sides.

A meticulous systemic examination was conducted in all the patients. All patients were subjected to the following investigations:
1. Routine blood investigations
2. Lipid profile (Serum triglycerides, HDL)
3. Random BSL
4. Spirometry

Spirometry was done by using Medi spiro digital spirometry machine, an electric spirometer in which the flow and volume measurement sensor is a digital turbine, based on the infrared interruption principal.
Interpretation of PFT parameters

	Obstructive	Restrictive	Mixed
FEV1	Decreased (<80% predicted normal)	Decreased (<80% predicted normal)	Decreased (<80% predicted normal)
FVC	Decreased or normal	Decreased	Decreased
FEV1/FVC	Decreased (<0.7)	Decreased or normal (>0.7)	Decreased (<0.7)

Definition of metabolic syndrome according to NCEP ATP III 2003(6).guidelines

Metabolic syndrome: Metabolic Syndrome was defined according to the Revised NCEP guidelines for metabolic syndrome. (1)It includes the following components:

Risk factor	Defining level
Abdominal obesity(waist circumference)	
Males	>90 cms
Females	>80 cms
Triglycerides	>150 mg
HDL cholesterol	
Males	<40mg/dl
Females	<50mg/dl
Blood pressure	>130/>85 mmHg
Fasting blood glucose	>100 mg
Three or more components are necessary to diagnose a case of metabolic syndrome.	

STATISTICALANALYSIS

Results of demographic, physical and biochemical characteristics were expressed as percentage, range, mean and median. Qualitative data was expressed in percentage and quantitative data expressed in mean±SD.

Statistical software

The Statistical software SPSS 23 was used for analysis of the data, Microsoft word and Excel version 13 were used to generate graphs and tables. Qualitative data was analysed by using Chi-square test and odds ratio. Quantitative data was analysed by using students unpaired t test for comparison between two groups. (p value of <0.05 was considered as significant)

Ethical issues: -

Written informedconsent will be obtained prior to enrolling cases and control subjects. Strict confidentiality of the data and subjects will be maintained. Institutional ethical committee clearance will be obtained before commencing the study.

RESULTS

Cases and controls were matched for age . In the present study maximum cases(29%) were in the age group 40 to 49 years. The mean age of cases was 49.2(+-S.D.) Range was 22 to 66 years.

There were 67% males as opposed to 33% females .The Male:Female ratio was 2:1 . Thus , there was a male preponderance in cases of Metabolic Syndrome.

In the present study, pulmonary function derangement were present in 71% cases as opposed 5% controls. This difference in pulmonary function test derangement among cases and controls was statistically highly significant (P value =0.0001) *(table 1)*.

Table 1: pulmonary function test in cases and controls

PFT dysfunction	Cases (n=100)	Controls (n=100)	Odds ratio	95%CI	Chi square value	P value
Yes	71(71%)	5(5%)	46.51	17.15 - 126.15	25.083	0.0001
No	29(29%)	95(95%)				

In the present study the mean values of pulmonary function tests variables were compared between cases and controls. Both FEV1 and FVC were significantly decreased in cases as compared to controls. (P value 0.009 and 0.01 respectively) However as both FEV1 and FVC were decreased , the FEV1/FVC ratio did not show significant difference in cases and controls(P value =0.08,NS) (table 2).

Table 2: Mean values of pulmonary function test variables in cases and controls

PFT parameters	Cases (n=100) Mean±SD	Controls (n=100) Mean±SD	P value
FEV1	66.18±1.08	87.88±6.68	0.009(S)
FVC	76.58±7.70	81.70±5.23	0.01(S)
FEV1/FVC	0.936±0.15	1.08±0.116	0.08(NS)

In the present study out of 100 cases of Metabolic Syndrome , 71 had pulmonary function test derangement. Out of these a maximum of 45 cases (63.38%) has restrictive pattern , followed by 15 cases (21.12 %) who had a obstrductive pattern and 11(15.49%) had mixed pattern of pulmonary function derangement. Thus ,a restrictive pattern of pulmonary function derangement was more predominant in cases of Metabolic Syndrome(table 3).

Table 3: Pattern of pulmonary function derangement in cases of metabolic syndrome

Pattern	Cases (n=100)	Controls (n=100)	Odds Ratio	95%CI	Chi square value	P value
Obstructive	15 (15%)	1 (1%)	17.47	2.26-135.02	13.32	0.0002(S)
Restrictive	45 (45%)	2 (2%)	3.6	1.98-6.69	18.31	0.0001(S)
Mixed	11 (11%)	2 (2%)	6.056	1.3065-28.0737	6.66	0.009(S)

In the present study individual component of metabolic syndrome were compared with the pattern of pulmonary function derangement. Increased waist circumference, high fasting blood glucose , high blood pressure were associated with restrictive pattern of lung dysfunction. Obstructive pattern was associated wih low HDL,high fasting blood glucose and high blood pressure . Mixed pattern was associated with increased waist circumference and low serum HDL.

Table7 Association of pulmonary function test derangement pattern with individual component of Metabolic Syndrome in cases In the present study , it was observed that pulmonary function derangement were more prevalent in male cases of metabolic syndrome as opposed to female cases. This difference in the prevalence of pulmonary function derangement in males and females was statistically significant (P value 0.04).

In the present study restrictive pattern was mpre prevalent in the age group of 30 to 39 years followed by 40 to 49 years and then that of 50-59 years of age group.(50%, 48.27%, 48.14% respectively)

Obstructive patterns was more prevalent in the age group of 50 to 59 years followed by 40 to 449 years and then 60 to 69 years. (25.92%, 13.79% , 12% respectively)

Mixed pattern was more prevalent in the age group of 40 to 49 years followed by 30 to 39 years of age group. (17.24%, 14.28%, 11.11% respectively)(table 13)

In the present study, type of pulmonary function derangement was studied in male and females . The difference in the pattern of pulmonary function derangement was not statistically different among males and females. However restrictive pattern was more prevalent in males and females(table 9).

Tables9: Gender difference in pattern of pulmonary function derangement in cases of metabolic syndrome

Pattern	Males (n=67)	Females (n=33)	Odds Ratio	95%CI	Chi square	P value
Obstructive	11(16.41%)	04(12.12%)	1.42	0.41-34.86		0.4(ns)
Restrictive	32(47.76%)	13(39.39%)	1.4	0.6-3.28	0.63	0.2(ns)
Mixed	06(8.95%)	05(15.15%)	0.55	0.15-1.95	1.81	0.5(ns)

In the present study , individual components ot metabolic syndrome were compared with type of pulmonary function derangement in both males and females. It was found that increased waist circumference was significantly associated with restrictive pattern in females than in males. this difference was statistically significant(P value=0.01)(table 11)

Tables 11: co relation of pattern of pulmonary function derangement with Sindividual components of metabolic syndrome according to gender (Chi square test)

Component of MS	Males (n=49)			Females (n=22)			P value		
	Obstructive (n=11)	Restrictive (n=32)	Mixed (n=6)	Obstructive (n=4)	Restrictive (n=13)	Mixed (n=5)	Obstructive	Restrictive	Mixed
Increased Waist circumference (>80cm in females; >90cm in males)	05(45.45%)	22(68.75%)	04(66.66%)	02(50%)	12(92.3%)	05(18.51%)	0.06	0.01	0.15
High Sr. Triglyceride (≥150 mg %)	05(45.45%)	20(62.5%)	04(66.66%)	02(50%)	08(61.53%)	02(40%)	0.07	0.08	0.05
Low Sr. HDL (<40mg% in males; <50mg% in females)	09(81.81%)	19(59.37%)	03(50%)	03(75%)	10(76.92%)	03(60 %)	0.07	0.05	0.9
High Blood Pressure (≥130 and/or ≥85 mm of Hg)	08(72.72%)	26(81.25%)	03(50%)	03(75%)	09(47.36%)	03(60%)	0.08	0.04	0.9
High Fasting plasma sugar (≥100mg %)	08(72.72%)	27(84.37%)	03(50%)	03(75%)	09(47.36%)	03(60%)	0.07	0.03	0.9

DISCUSSION

A link between metabolic syndrome (MetS) and lung diseases has been observed in several cross-sectional and longitudinal studies. This syndrome has been identified as an independent risk factor for worsening respiratory symptoms, greater lung function impairment, pulmonary hypertension, and asthma.

In the present study maximum (29%) cases were in the age group of 40 -49 years with the mean age of 49.24 for both the cases as well as controls. Study conducted by Medhat et al included 16 males and 29 females with average age was 54.29±7.61 years old in cases and controls included 4 males and 11 females with average age 53.3±6.62 years old(7). Medhat F. Negm et al found that was more common in females (64.4%) than males (35.6%)(7).

In this study, results revealed that the prevalence of restrictive pattern among metabolic syndrome group was (63%) followed by obstructive pattern i.e. 21.12% and then mixed pattern 15.49% with the p value of 0.0002, 0.0001 and 0.009 respectively.

Results were similar with the study conducted by K.Kakajima in October 2008 which showed that impaired restrictive pulmonary function, but not obstructive pattern is associated with metabolic syndrome when studied in 2396 adults .(8)

Lin et al. demonstrated an association between MS and restrictive lung impairment after adjustment for age, gender, BMI, smoking, alcohol drinking, and physical activity.(9)

Association of PFT variables with individual components of MS in cases was studies.

The difference was not statistically significant in all components in ratio of FEV1/FVC. The difference was significant in increased waist circumference and high Sr. triglycerides in both i.e.FEV1 (p value 0.001 and 0.05 respectively) and FVC (p value 0.01 and 0.04 respectively) variable in which FEV1 of increased waist circumference was highly significant in all variables. Only FEV1 was statistically significant in Low Sr.

HDL (P value 0.04) and high Blood Pressure component (P value 0.05). All the component of high fasting plasma sugar were not significant. (P value > 0.05) We have applied unpaired t test for the comparison in metabolic syndrome component.Each component of metabolic syndrome may have a different influence on pulmonary function.

Paolo Rogliani studied pulmonary functions in metabolic syndrome in January 2010 had somewhat similar results i.e. obesity has been shown to be inversely related to lung function. Fasting serum insulin levels are negatively correlated with FVC and FEV1.

HDL-C was the strongest predictor of FEV1 and FVC, with an inverse association that has been observed both in smokers and in non-smokers.(10)

Medhat F. Negm in November 2016 stated that all diagnostic factors such as abdominal obesity, elevated blood pressure, high FBS, high triglycerides, and low HDL-C were significantly linked with reduced FVC % predicted and FEV1% in cases of metabolic syndrome.(7)

Impairment of pulmonary function among those with metabolic syndrome is due to abdominal obesity which is considered the core of the pathophysiology of metabolic syndrome(11).

On studying gender differences regarding pulmonary function tests derangement it was found that differences in males and females; 49(73.13%) and 22 (66.67%) viz.

pulmonary function tests derangement was statistically significant (p value 0.04) with odds ratio of 1.36. Bae et al found that men with metabolic syndrome experienced more lung function impairment when compared with women.(7)

C. W. Baffi also conducted the similar study 'Metabolic syndrome and lung' in 2016 and found that there was a stronger association between MetS (as a whole or related to its individual components) and incident asthma in females (hazard ratio [HR], 1.5; 95% CI,1.10-2.05) than in males (HR, 1.24; 95% CI, 0.95-1.61).(12)

CONCLUSION

Conclusions drawn from our study were as follows

1. Maximum cases of metabolic syndrome were in the age group 40 to 49 years.(mean age 49.2 years)
2. The prevalence of metabolic cases was more in males as compared to females.(male :female ration 2.1:1)
3. Pulmonary function tests were altered in cases of metabolic syndrome as compared to healthy controls.
4. Restrictive pattern was the most common respiratory dysfunction pattern among cases both males as well as females.
5. Abdominal obesity (Increased waist circumference) was profoundly associated with pulmonary dysfunction along with high serum triglycerides, low serum HDL and high blood pressure.
6. Significant gender difference was noted in mean values of pulmonary function test variables among males and females.
7. The difference regarding pattern of pulmonary dysfunction was not statistically significant among males and females.
8. Restrictive pattern of lung disease associated with abdominal obesity (increased waist circumference) was found more prevalent in females as compared to males.
9. High blood pressure and high fasting blood glucose were associated with restrictive lung disease with more prevalence in males as compared to females.
10. Pulmonary function derangement increases as the age advances in cases of metabolic syndrome.

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