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PULMONARY FUNCTION TEST ABNORMALITY IN PATIENTS OF METABOLIC SYNDROME ADMITTED IN KMCH, BIHAR, INDIA.

General Medicine

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ABSTRACT

Objectives: This study was to explore the association between impaired lung function and metabolic syndrome. And it was also to evaluate the relationship between Metabolic Syndrome and pulmonary function dysfunction based on the changes in Metabolic Syndrome diagnostic criteria and pulmonary function indices in terms of Forced Expiratory Volume in one second (FEV1), Forced Vital Capacity (FVC) and FEV1/FVC ratio. **Methods:** A detail history, clinical examinations and relevant investigations were performed to all patients. Assessment of the metabolic syndrome was made according to the criteria proposed by NATIONAL COLESTEROL EDUCATION PROGRAME (NCEP) Adult Treatment Panel III (ATP III). Spirometry was performed by using automated spirometer based on American Thoracic Society recommendation. FVC (Forced vital capacity), FEV1 (forced expiratory volume in one second) and FEV1/FVC ratio were observed. **Results:** most of patients 65% (52) were males. And majorities of the patients were belonged in the age group 41-50 years.56(70%) had pulmonary dysfunction. 56(70%) cases had FVC of <80%. 44 cases (RLD 36 and MLD 8) (55%) had FVC <80% of predicted. 60(75%) cases had FEV1/FVC ratio>0.7%. Out of 53 male, 26 patients (50%) had Restrictive pattern. Out of 28 female, 10(35.71%) patients had Restrictive pattern, and also 10(35.71%) had normal pattern of pulmonary function test. Out of 80 cases, 36(45%) patients had Restrictive pattern, and 24(30%) patients had normal pattern of pulmonary function test. **Conclusions:** Metabolic syndrome is more preponderance in middle age males than females. Pulmonary dysfunction is commonly seen in metabolic syndrome. Obstructive lung disease is a very common pulmonary dysfunction. Abdominal obesity measured by increased waist circumference is a strong predictor of pulmonary dysfunction. High serum triglycerides, low serum HDL, high blood pressure and fasting blood sugar are also associated with pulmonary dysfunction in metabolic syndrome patients.

KEYWORDS

Metabolic Syndrome, Pulmonary Dysfunction, Laboratory Investigations, Age Group, Gender

INTRODUCTION

Metabolic Syndrome is defined as constellation of interconnected physiological, biochemical, clinical and metabolic factors and is characterized by clustering of abdominal obesity, hypertension, insulin resistance and dyslipidaemia [1].

South Asia is home to 25% of world population and here there is tendency of epidemiological transition from rural areas to suburban and urban areas, resulting in dramatic decrease in infectious diseases and the proportionate increase in the chronic non- infectious diseases [2].

The recent study has shown that the impaired pulmonary function is associated with all causes and cardiovascular mortality [3] . There is increasing evidence that the impaired lung function is more than a simple reflection of airflow limitation and it is a marker of premature death [4]. The positive relationship between impaired lung function and metabolic syndrome has been shown in different cross-sectional and large cohort studies [5]. Moreover, dyslipidaemia has been a biomarker of the abnormal lung function [6] and so is obesity[7].

There is increasing evidence of impaired lung function in patient of metabolic syndrome which is a marker of premature death [8]. Several large studies have shown that lung function dysfunction was predictive of the increased cardiovascular morbidity and mortality, independently of smoking [9]. Positive association between lung function dysfunction and cardiovascular mortality has been seen in cases of Hypertension, Type 2 Diabetes Mellitus and overall obesity [10]. Many of these stated factors are the components of Metabolic Syndrome too. The metabolic syndrome itself is a cluster of cardiovascular risk factors [11].

The mechanism of underlying relationship between impaired lung function and cardiovascular risk factors are unclear. Few data are available on association between lung function impairment and Metabolic Syndrome. This is especially so in our part of the country. It is therefore, worthwhile to study the association between lung function and Metabolic Syndrome. Objectives of our study was to explore the association between impaired lung function and metabolic syndrome. And it was also to evaluate the relationship between Metabolic Syndrome and pulmonary function dysfunction based on the changes in Metabolic Syndrome diagnostic criteria and pulmonary function indices like Forced Expiratory volume in one second (FEV1), Forced Vital Capacity (FVC) and FEV1/FVC ratio.

MATERIAL AND METHODS

A total of 80 patients of metabolic syndrome with age group of 20 years to 60 years were enrolled in this study. This study was conducted in the Department of Medicine, Katihar Medical College & Hospital, Katihar, Bihar during a period from November 2018 to May 2020.

INCLUSION CRITERIA

Selection of the cases of Metabolic Syndrome were made among patients attending OPD and those admitted in IPD in department of Medicine, Katihar Medical College & Hospital, Katihar, Bihar, India.

A. Assessment of the metabolic syndrome in this particular study was made according to the criteria proposed by NATIONAL COLESTEROL EDUCATION PROGRAME (NCEP) Adult Treatment Panel III (ATP III) which states that three or more of the following risk factors make the diagnosis of the Metabolic Syndrome [12,13]:-

1. Blood pressure 130/85 or higher
2. Triglyceride 150 mg/dl (1.7mmol/liter) or higher
3. HDLC less than 40 mg/dl (1 mmol/liter) for male and >50 mg/dl (1.3 mmol/liter) for women
4. Fasting blood sugar 100 mg (5.6 mmol/liter) or higher
5. Abdominal obesity defined by Asia Pacific cut off limits (waist circumference 90 cm or more for men and 80 cm or more for women).

EXCLUSION CRITERIA

1. Patients less than 20 years of age and more than 60 years of age. Pregnancy and Smoker were also excluded from the study
2. Infectious disease like Pneumonia, Pulmonary tuberculosis, acute and chronic febrile illness. Pulmonary diseases like chronic bronchitis, Bronchial asthma, chronic obstructive pulmonary disease, Interstitial lung diseases, emphysema. Endocrine, cardiac, renal and neurological diseases, Hematological disease and Malignancy, Psychiatric disease were excluded.

METHODS

A detail history, clinical examinations and relevant investigations were performed to all patients. Demographic background, medical history, drug use and lifestyle factors such as cigarette smoking and alcohol consumption were noted as per standardized questionnaire.

Routine examination of the urine for sugar, albumin, bile pigment, bile salt, urobilinogen was done. Blood examinations like complete blood

count, fasting blood sugar, urea and creatinine were also done.

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4. Fasting blood sugar 100 mg (5.6 mmol/liter) or higher
5. Abdominal obesity defined by Asia Pacific cut off limits (waist circumference 90 cm or more for men and 80 cm or more for women) [118,119].

SPIROMETRY

The lung function test was performed by the expert and experienced technician using an automated spirometer based on American Thoracic Society recommendation [25].

Patients were instructed to sit up on the chair straight with the feet flat on the floor and the legs uncrossed. Before performing the forced expiration, tidal (normal) breath was taken first followed by deep breath using the mouth piece and then further quick full inspiration. For FEV1 patient was asked to take deep breath in as large as possible and blow as hard and as fast as possible. This was kept going until no air was left. The patients were instructed not to use bronchodilator or smoke on the day of the pulmonary function test as per recommendation of American Thoracic Society -.

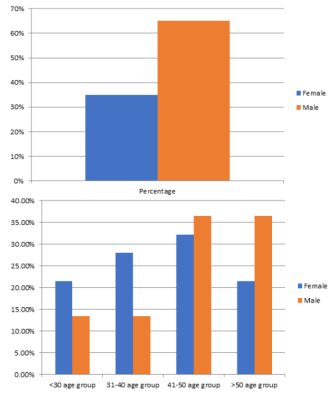
The values used in the study were FVC (Forced vital capacity), FEV1 (forced expiratory volume in one second) and FEV1/FVC ratio. Obstructive lung impairment (disease) was defined as FEV1/FVC <70% and FVC>80% of the predicted value whereas restrictive lung impairment (disease) was defined as FEV1/FVC>70% and FVC<80% of the predicted value. Mixed lung impairment (disease) was defined FEV1/FVC ratio <70% and FVC<80% of the predicted value. The other was defined as normal lung function [25].

STATISTICALANALYSIS

Data was analyzed by using simple statistical methods with the help of MS-Office software.

RESULTS

Out of 80 patients, 65%(52) were male and 35% (28) were female. Most of the patients were belonged in the age group 41-50 years in which Males were 19(36.53%) and Females were 9(32.14%).



Out of 80 cases, 56 cases (70%) had pulmonary dysfunction and 24 cases (30%) had no pulmonary dysfunction. 56(70%) cases had FVC of <80% and 24 cases (30%) had FVC of >80%. 44 cases (RLD 36 and MLD 8) (55%) had FVC <80% of predicted value whereas 36 cases (45%) had normal FVC percentage of predicted value. 20 (25%) cases had FEV1/FVC ratio of <0.7 and 60(75%) cases had FEV1/FVC ratio>0.7%.

Table.1. Gender wise distribution of Pattern of Pulmonary dysfunction in Metabolic Syndrome.

Pattern	Male n=52		Female n=28	
	No	%	No	%
Obstructive	8	15.38%	4	14.28%
Restrictive	26	50%	10	35.71%
Mixed	4	7.69%	4	14.28%
Normal	14	26.92%		35.71%

Out of 53 Male, 26 patients (50%) had Restrictive pattern,8 patients (15.32%) had Obstructive pattern,4 Patients (7.69%) had mixed pattern and 14 patient (26.92%) had normal pattern of pulmonary function test. Out of 28 cases Female 10(35.71%) patients had Restrictive pattern,4 (14.28%) had Obstructive pattern,4(14.28%) had Mixed pattern and 10(35.71%) had normal pattern of pulmonary function test.

Table.2. Pattern of Pulmonary function derangement in cases of Metabolic Syndrome.

Pattern	Cases	Percentage
Obstructive	12	15%
Restrictive	36	45%
Mixed	8	10%
Normal	24	30%

Out of 80 cases, 36 patients had Restrictive pattern, 12 (15%) patients had Obstructive pattern, 8(10%) patients had Mixed pattern and 24(30%) patients had normal pattern of pulmonary function test.

Table.3. Correlation of pattern of Pulmonary Function derangement with individual component of Metabolic Syndrome according to Gender.

	MALE			FEMALE		
	Obstructive n=9	Restrictive n=26	Mixed n=4	Obstructive n=3	Restrictive	Mixed
Waist Circumference >80 cm Female >90 cm Male	4(45.05%)	18(69.23%)	3(75%)	2(66.6%)	9(90%)	4(100%)
Serum Triglycerides>150 mg/dl	4(45.05%)	17(65.38%)	3(75%)	2(66.6%)	6(60%)	2(50%)
Low HDL <40 mg/dl Male <50 mg/dl Female	7(77.7%)	18(69.2%)	2(50%)	2(66.6%)	7(70%)	2(50%)
Blood Pressure >130/85 mm Hg	6(66.6%)	21(80.76%)	2(50%)	2(66.6%)	5(50%)	2(50%)
Fasting Plasma Sugar >100 mg/dl	6(66.6%)	22(84.6%)	2(50%)	2(16.6%)	5(50%)	5(50%)

DISCUSSION

In the present study it is evident that anthropometric measurement (waist circumference), clinical (blood pressure), biochemical (Triglycerides, High density lipoprotein and Fasting blood sugar) and pulmonary function test variables (FEV1%,FVC%,FEV1/FVC ratio) are significantly abnormal. These findings are similar to that of Korean study by Lim et al [13] and Taiwan study by Chen et al [14].

In our study, gender wise distribution of cases of Metabolic Syndrome in which of total 80 cases, 65% were males and 35% were females. This incidence is similar to that of a study by Chaudary H C et al JAPI 2018 VOL 66 [13] where they have shown that 70% of Metabolic Syndrome were male while 30% female. Our finding is again similar to that of Myoung Sook Bae et al [15] who has stated that distribution of Metabolic Syndrome was statistically high in male than women.

In our study, maximum number of cases were belonged to 41-50 years of age group in which (36.53%) cases were males. This is similar to the study of Joshi R W et al[16] which shows that 29% of the cases were in the age group of 40-49 years. This is also similar to the study by Yi-Yen Lee et al [17] which showed that significant negative correlation between variables of Metabolic Syndrome and pulmonary dysfunction at 45 years of the age.

Pulmonary dysfunction was present in 70 % of the cases whereas in 30% of the cases of Metabolic Syndrome there was no pulmonary dysfunction. This is similar to the results of Joshi et al[142] which showed that 71% of cases of Metabolic Syndrome had pulmonary function derangement whereas in 29 % of cases there was no Pulmonary Dysfunction.

In our study, 25% cases of Metabolic Syndrome FEV1% of predicted value had less than normal while in 75% of cases had normal. This is similar to the study by Gholamreza et al [18] which showed that FEV1% of predicted value was significantly lower in cases of Metabolic Syndrome. FVC% of predicted value was less than normal on 55 % of the cases, whereas it was normal in 45% of the cases. This result was similar to study of Pakistan by Irfan et al[19] in which there was considerable decrement in FVC and FEV1 in Diabetic cases.

In our study, FEV1/FVC ratio was reduced in 25% of the cases whereas it was normal in 75% of cases. This was similar to a study by Chen et al [20] who found negative correlation between FEV1/FVC and waist circumference. Most common form of the pulmonary dysfunction was Restrictive pattern which was present in 50% cases of Metabolic Syndrome in male and 35.71% in female. It was followed by of obstructive pattern of pulmonary dysfunction which was found in 15.38% of Metabolic Syndrome in male and 14.28% in female and then mixed pattern of the pulmonary dysfunction which was found in 7.69% Metabolic Syndrome in male and 14.28% in female. The result of our study was similar to that of Joshi R W et al[16] which showed that restrictive pattern was found in 63% of Metabolic Syndrome cases followed by Obstructive pattern 21.12% of cases and then Mixed pattern in 15.49% of cases. Most common pattern of pulmonary dysfunction was Restrictive lung disease (45%), that is followed by Obstructive pattern (Obstructive lung disease) 15% and then Mixed pattern (Mixed lung disease 10%). This is similar to the finding of Chaudary S C et al JAPI 2018 VOL 66 in which Restrictive pattern was 42%, Mixed pattern was 11%.

In our study, correlation of various variables of individual component of Metabolic Syndrome in different patterns of pulmonary derangement was according to gender. Waist circumference is most important predictor of pulmonary dysfunction and is abnormal in 69.23% cases of Restrictive pattern in male and 90% in Female. This is similar to the study by Gholamreza et al[18] which revealed that waist circumference was most important predictor of pulmonary dysfunction. Our study showed thar low HDL was second most powerful negative predictor of FEV1 and FVC and was present in 69.20% of male and 70% of female in the form of Restrictive pattern abnormality. This is similar to the study by Gholamreza et al [18]who found that HDL was significant negative predictor of FEV1 and FVC. High serum triglyceride was third important predictor of pulmonary function derangement and was present in 65.38% of the male and 60% of female in Restrictive pattern abnormality of pulmonary function test. This is similar to a finding of Gholam- Reza et al[18].

In this present study, next important predictor for pulmonary function derangement was high fasting plasma sugar which was present in 84.6% of male and 50% of female in the form of restrictive pattern abnormality in pulmonary dysfunction. This was again supported by a survey in Pakisthan by Irfan et al [19]. This is again consistent with a Korean survey by Kim C H et al [20] and American Indian study in USA by Yeh Fawn etal(144) and Gholam reza et al[18].

High blood pressure was associated with significant number pulmonary derangement. It was associated with 80.7% cases of Restrictive lung disease in males and 50% cases of Restrictive lung disease in Female. This is consistent with study by Gholam reza et al who stated that elevated systolic blood pressure and diastolic pressure were among the most common component of Metabolic Syndrome and were associated pulmonary dysfunction especially [18]. This is again similar to the study of Chaudhary H C et al 1190 who found that hypertension was significantly was associated with Metabolic Syndrome. Raised fasting blood sugar had inverse relationship with pulmonary function. This results was similar to the results of study of a survey in Pakistan by Irfan et al 2011 which revealed a considerable detrimental effect of high fasting blood sugar on FVC, FEV1 in diabetic as compared to non diabetic[19].

Several explanations have been proposed to explain this relationship between reduced lung function and Metabolic Syndrome. It has been said that Metabolic syndrome is the cluster of diseases comprising of multiple cardiovascular risk factors like dyslipidemia, glucose intolerance, hypertension and insulin resistance all of which can crop up from visceral adiposity which is responsible for physiological impairment of respiratory function adversely affecting FEV1,FVC,FEV1/FVC ratio. Abdominal obesity predisposes to decrease in peripheral airway diameter, reduction in respiratory compliance, increase in ventilatory efforts and also increase in airway hypersensitivity [21]. These findings are consistent with that of our study in which Metabolic Syndrome was significantly associated with pulmonary function derangements. It is explained that mechanical effects of truncal obesity and inflammatory effects of the ectopic adipose tissue [139] are responsible for impaired lung function. Lower level of ventilation at lung bases may lead to closure of basal lung respiratory units distorting the ventilation perfusion ratio resulting in arterial hypoxia particularly in supine position [22]. The waist circumference is correlated with both subcutaneous adipose tissue and intra abdominal adipose tissue but the latter is deleterious in the form of ectopic fat deposition. Nevertheless, adipose tissue is an active endocrine organ which secretes a number of proinflammatory adipocytokines, IL-6, TNF-alpha, leptin which negatively regulate the insulin sensitivity and anti-inflammatory activities [23]. The insulin resistance is a common feature of raised fasting blood sugar and abnormal lung function with respiratory ventilatory defects which has been reported in the patients of diabetes mellitus.

In our study, FEV1/FVC ratio was significantly reduced in cases of Metabolic Syndrome with Obstructive lung disease. This was similar to the study of Netherland by Van Huissted et al 2013 showing that there was small but significant reduction in FEV1/FVC ratio in patient with Metabolic Syndrome. FVC reduction was significant predictor of the pulmonary function dysfunction and this was similar to the study Gholamreza et al [24].

SUMMARY

Incidence of the Restrictive lung disease is 45%, obstructive lung disease was 15% and Mixed lung disease was 10% of Metabolic Syndrome cases(table 8).This finding is consistent with the finding of a cross- sectional survey in India by Chaudary et al[125] which had revealed that 33% of Metabolic Syndrome cases presented with Restrictive lung disease,13% presented with Obstructive lung disease and 4 % WITH MIXED LUNG DISESE[125]. The case of Metabolic Syndrome revealed significantly lower FVC % of the predicted value, FEV1 percentage of predicted value and FEV1/FVC ratio. Subjects with Metabolic Syndrome showed significantly lower FVC % of predicted value, FEV1% of predicted value and FEV1/FVC ratio. The disease pattern associated with Metabolic Syndrome that is Restrictive lung disease, Obstructive lung disease and Mixed lung disease and associated pulmonary function indices did not differ gender wise significantly.

We found a positive independent relationship between the various components of Metabolic Syndrome and impaired lung function. This finding of our study is extensively supported by the various studies both in India and abroad. But there are scanty number of studies in India especially in our part of the country and therefore further prospective studies are needed to determine the temporal and causal relationship between lung function impairment and Metabolic Syndrome to clarify the underlying pathophysiological mechanism.

CONCLUSIONS

This study concluded that the metabolic syndrome is more preponderance in middle age males than females. Pulmonary dysfunction is very commonly in metabolic syndrome patients. Obstructive lung disease is a very common pulmonary dysfunction. Abdominal obesity measured by increased Waist circumference is a strong predictor of pulmonary dysfunction. High serum triglycerides, low serum HDL, high blood pressure and fasting blood sugar are also associated with pulmonary dysfunction in metabolic syndrome patients.

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