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Original Research Article

A Study to Assess the Pulmonary Function Tests in Patients of Metabolic Syndrome: an Observational Study

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Abstract

Aim: The aim of the present study was to assess the pulmonary function tests in patients of metabolic syndrome and to record the effects of metabolic syndrome on pulmonary function tests.

Methods: The study was conducted in the Department of Medicine. 50 patients of metabolic syndrome presenting in the OPD/IPD of Anugrah Narayan Magadh Medical College and Hospital, Gaya, India for related or unrelated problems were selected for the current study and were included in the study group after applying inclusion and the exclusion criteria and after taking written informed consent. The NDD spirometer was used to conduct pulmonary function tests in this study.

Results: Majority of the patients were women (72%) (n=36) while men constituted 28% (n=14) of the patients. Most of the patients belonged to the 61-70 years' age group (n=17) followed by 41-50 years' age group (n=13). 42% (n=21) of the patients had 4 components positive out of 5 while 36% (n=18) of the patients had 3 components positive. 22% (n=11) of the patients had all 5 components positive. Most of the patients had a restrictive pattern (44%) (n=22). 34% (n=17) of the patients had a mixed pattern while 16% (n=8) of the patients had a normal picture. Only 6% (n=3) of the patients had an obstructive pattern ($p<0.001$). Both FEV1 and FVC correlated negatively with BMI, FBS, waist hip ratio and SBP. Only FEV1 had a negative correlation with Hba1c whereas only FVC had a negative correlation with waist circumference.

Conclusion: Our study provides an understanding on how obesity aids to the development of lung function decline and the interplay between metabolic syndrome and lung function. Patients with metabolic syndrome have significant impairment of the pulmonary function with restrictive pattern being the most common one.

Keywords: Metabolic syndrome, Pulmonary function tests, FEV1, FVC

Introduction

Impaired pulmonary function, which includes measurements of forced expiratory volume in one second (FEV1) and forced vital capacity (FVC), is mainly present in individuals with chronic obstructive pulmonary disease (COPD) and asthma. [1] Previous studies have shown that reduced FEV1 is a strong predictor of coronary heart disease, COPD-related mortality, and cardiovascular mortality. [2-4] Reduced FVC is also a marker for increased mortality in asymptomatic adults [5] or individuals with metabolic syndrome. [6] Recent years have seen an increased focus on metabolic syndrome in the prediction of lung function impairment. Previous data from Asian [7,8] and European [9,10] patients demonstrated a substantial association between impaired pulmonary function and metabolic syndrome. However, the diagnostic criteria and clinical features of metabolic syndrome varied by race. Few studies have focused on the U.S. general population to investigate the association between lung capacity and metabolic syndrome. In addition, important risk factors [8,11,12] such as

gender, smoking status, biomarkers of inflammation, and C-reactive protein (CRP), were not fully taken into account in previous studies.

Parameters for pulmonary function status are obtained through spirometry, which is the test of choice to assess lung function. [13] It is simple to execute for those who are well instructed and is routinely performed by health care professionals, for example, in primary care or during health examinations of workers. [14,15] A comparison of the values obtained in the test with the theoretical values, estimated from validated formulas (according to age, sex, height, etc), provides information on the lung condition. [16,17] It is, therefore, an essential public health tool for primary, secondary, and tertiary prevention of pathologies with a high impact on the population. [18]

In this context, health care professionals, who play an essential role in disease prevention and health promotion, have a tool that, when used efficiently, would help to detect problems beyond pulmonary deterioration. [19] Regarding the latter, given that the onsets of MetS is reflected in spirometric variables, and its risk factors also do so independently, it is relevant to know whether a progressive deterioration of lung function is caused by the individual presence of the risk factors characterizing MetS. Thus, through public health programs (hospitals, communities, workplaces, etc) that include the study of these parameters from the perspective of cardiometabolic alterations, it would be possible to detect the risk factors and treat them early to prevent the development of MetS.

The aim of the present study was to assess the pulmonary function tests in patients of metabolic syndrome and to record the effects of metabolic syndrome on pulmonary function tests.

Materials and Methods

The study was conducted in the Department of Medicine, Anugrah Narayan Magadh Medical College and Hospital, Gaya, India for one year . 50 patients of metabolic syndrome presenting in the OPD/IPD of Anugrah Narayan Magadh Medical College and Hospital, Gaya, India for related or unrelated problems were selected for the current study and were included in the study group after applying inclusion and the exclusion criteria and after taking written informed consent. The NDD spirometer was used to conduct pulmonary function tests in this study.

According to the new IDF definition, for a person to be defined as having the metabolic syndrome, they must have: central obesity (defined as waist circumference with ethnicity specific values) plus any two of the following four factors.

Restrictive lung impairment was defined as: FVC <80% of the predicted value and FEV1 -to-FVC ratio >70%. Mixed lung impairment was defined as: FEV1 -to-FVC ratio <70% and FVC <80% of the predicted value. Waist was measured in a horizontal plane midway between lowest rib and the iliac crest. Patients fulfilling the IDF criteria for metabolic syndrome were selected for the study. The following patients were excluded from the study: Smokers, non-ambulatory patients, thoracic cage abnormalities, diaphragmatic paralysis, occupational exposure to substances like silica, asbestos, coal, beryllium, patients suffering from Asthma/COPD, myopathies. A proper history was taken from the patients and other available sources. A thorough general physical and systemic examination was done and final diagnosis was made after doing all the necessary investigations.

The study was approved by the Ethical Committee of the Institute. Data thus obtained were analysed statistically. The Data was expressed as mean with standard deviation (SD) for quantitative variables. Comparisons between groups were performed using Student's t-test and Anova test for quantitative variables and Chi-square test for nominal/qualitative data. A value of $p<0.05$ was taken as significant.

Results

Table 1: Baseline characteristics

Gender	**N**	**%**
Male	36	72
Female	14	28
Age groups in years		
<40		
41-50	13	26
51-60	11	22
61-70	17	34
>70	9	18
Components of metabolic syndrome		
3 components	18	36
4 components	21	42
5 components	11	22

Majority of the patients were women (72%) (n=36) while men constituted 28% (n=14) of the patients. Most of the patients belonged to the 61-70 years' age group (n=17) followed by 41-50 years' age group (n=13). 42% (n=21) of the patients had 4 components positive out of 5 while 36% (n=18) of the patients had 3 components positive. 22% (n=11) of the patients had all 5 components positive.

Table 2: Distribution of the patients according to the PFT pattern

PFT pattern	N	%
Restrictive	22	44
Obstructive	3	6
Mixed	17	34
Normal	8	16

Most of the patients had a restrictive pattern (44%) (n=22). 34% (n=17) of the patients had a mixed pattern while 16% (n=8) of the patients had a normal picture. Only 6% (n=3) of the patients had an obstructive pattern (p<0.001).

Table 3: Correlation of FEV1 and FVC with different variables

	FEV1		FVC	
	r value	P value	r value	P value
Waist circumference	0.028	0.832	-0.023	0.865
BMI	-0.105	0.416	-0.111	0.386
Waist/Hip ratio	-0.096	0.472	-0.076	0.552
SBP	-0.058	0.664	-0.082	0.547
FBS	-0.072	0.590	-0.118	0.373
Hba1c	-0.003	0.95	0.026	0.864

Both FEV1 and FVC correlated negatively with BMI, FBS, waist hip ratio and SBP. Only FEV1 had a negative correlation with Hba1c whereas only FVC had a negative correlation with waist circumference.

Discussion

Metabolic syndrome, also known as "Insulin resistance syndrome", "American syndrome", and "syndrome X", is defined as at least three of the five following medical conditions: central obesity (mandatory), high blood pressure, high blood sugar, high serum triglycerides, and low serum high-density lipoprotein (HDL). There has been an epidemiological transition in the recent past leading to an increase in non – infectious diseases. Among these non- infectious diseases, metabolic syndrome is one of the most important ones. More than one-fifth of the population and roughly 60% of obese individuals are affected. [20] The key feature of metabolic syndrome is central obesity, which is also known as visceral obesity, apple-shaped adiposity, or male pattern obesity. There is accumulation of adipose tissue predominantly around the waist and trunk. Associated conditions include hyperuricemia; fatty liver (especially in concurrent obesity) progressing to non- alcoholic fatty liver disease; polycystic ovarian syndrome in women, erectile dysfunction in men; and acanthosis nigricans. [21]

Majority of the patients were women (72%) (n=36) while men constituted 28% (n=14) of the patients. Similar pattern of sex distribution was seen in the study conducted by Negm et al where 64.4% patients were females and 35.6% patients were males and in the study conducted by Huisstede et al in which majority of the subjects were females. [22,23] Most of the patients belonged to the 61-70 years' age group (n=17) followed by 41-50 years' age group (n=13). 42% (n=21) of the patients had 4 components positive out of 5 while 36% (n=18) of the patients had 3 components positive. 22% (n=11) of the patients had all 5 components positive. Most of the patients had a restrictive pattern (44%) (n=22). 34% (n=17) of the patients had a mixed pattern while 16% (n=8) of the patients had a normal picture. Our study showed that patients with metabolic syndrome primarily had a restrictive pattern (43.3%) (p<0.001) which is in accordance with studies conducted by Chaudhary et al, Rogliani et al and majority of the other studies which also showed a predominantly restrictive pattern in patients of metabolic syndrome. [24]

Only 6% (n=3) of the patients had an obstructive pattern (p<0.001). Both FEV1 and FVC correlated negatively with BMI, FBS, waist hip ratio and SBP. Only FEV1 had a negative correlation with Hba1c whereas only FVC had a negative correlation with waist circumference which was consistent with the study conducted by Chen et al [25], Bae et al [26] and majority of the other studies, the strongest correlation of FEV1 being with BMI as was shown in the study conducted by Chaudhary et al [27] and Yeh et al [28] which found obesity to be the strongest predictor of deterioration in pulmonary function tests and that of FVC being with plasma

glucose levels as was shown in the study done by Adeyeye et al. [29]

Conclusion

Our study provides an understanding on how obesity aids to the development of lung function decline and the interplay between metabolic syndrome and lung function. Patients with metabolic syndrome have significant impairment of the pulmonary function with restrictive pattern being the most common one.

References

1. Mannino DM, Ford ES, Redd SC. Obstructive and restrictive lung disease and markers of inflammation: data from the Third National Health and Nutrition Examination. Am J Med. 2003 Jun 15;114(9):758-62.
2. 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 Jun;127(6):1952-9.
3. Schroeder EB, Welch VL, Couper D, Nieto FJ, Liao D, Rosamond WD, Heiss G. Lung function and incident coronary heart disease: the Atherosclerosis Risk in Communities Study. Am J Epidemiol. 2003 Dec 15;158(12): 1171-81.
4. Sin DD, Man SF. Chronic obstructive pulmonary disease as a risk factor for cardiovascular morbidity and mortality. Proc Am Thorac Soc. 2005;2(1):8-11.
5. Burney PG, Hooper R. Forced vital capacity, airway obstruction and survival in a general population sample from the USA. Thorax. 2011 Jan;66(1):49-54.
6. Lee HM, Chung SJ, Lopez VA, Wong ND. Association of FVC and total mortality in US adults with metabolic syndrome and diabetes. Chest. 2009 Jul;136(1):171-176.
7. Yoshimura C, Oga T, Chin K, Takegami M, Takahashi K, Sumi K, Nakamura T, Nakayama-Ashida Y, Minami I, Horita S, Oka Y, Wakamura T, Fukuhara S, Mishima M, Kadotani H. Relationships of decreased lung function with metabolic syndrome and obstructive sleep apnea in Japanese males. Intern Med. 2012;51(17):2291-7.
8. Choi JH, Park S, Shin YH, Kim MY, Lee YJ. Sex differences in the relationship between metabolic syndrome and pulmonary function: the 2007 Korean National Health and Nutrition Examination Survey. Endocr J. 2011;58 (6):4 59-65.
9. Rogliani P, Curradi G, Mura M, Lauro D, Federici M, Galli A, Saltini C, Cazzola M. Metabolic syndrome and risk of pulmonary involvement. Respir Med. 2010 Jan;104(1):47-51.
10. Fimognari FL, Pasqualetti P, Moro L, Franco A, Piccirillo G, Pastorelli R, Rossini PM, Incalzi RA. The association between metabolic syndrome and restrictive ventilatory dysfunction in older persons. J Gerontol A Biol Sci Med Sci. 2007 Jul;62(7):760-5.
11. Yang T, Chu CH, Hsieh PC, Hsu CH, Chou YC, Yang SH, Bai CH, You SL, Hwang LC, Chung TC, Sun CA. C-reactive protein concentration as a significant correlate for metabolic syndrome: a Chinese population-based study. Endocrine. 2013 Apr;43(2):351-9.
12. Leone N, Courbon D, Thomas F, Bean K, Jégo B, Leynaert B, Guize L, Zureik M. Lung function impairment and metabolic syndrome: the critical role of abdominal obesity. Am J Respir Crit Care Med. 2009 Mar 15;179(6): 509-16.
13. Global initiative for chronic obstructive lung disease. Global Strategy for the Diagnosis, Management, and Prevention of Chronic Obstructive Pulmonary Disease. 2020.
14. Represas-Represas C, Botana-Rial M, Leiro-Fernández V, González-Silva AI, García-Martínez A, Fernández-Villar A. Short- and long-term effectiveness of a supervised training program in spirometry use for primary care professionals. Arch Bronconeumol. 2013 Sep;49(9):378-82.
15. Ranzieri S, Corradi M. Conducting spirometry in occupational health at COVID-19 times: international standards. Med Lav. 2021 Apr 20 ;112(2):95-106.
16. Martín de Vicente C, de Mir Messa I, Rovira Amigo S, Torrent Vernetta A, Gartner S, Iglesias Serrano I, Carrascosa Lezcano A, Moreno Galdó A. Validation of Global Lung Function Initiative and All Ages Reference Equations for Forced Spirometry in Healthy Spanish Preschoolers. Arch Bronconeumol (Engl Ed). 2018 Jan;54(1):24-30.
17. Quanjer PH, Stanojevic S, Cole TJ, Baur X, Hall GL, Culver BH, Enright PL, Hankinson JL, Ip MS, Zheng J, Stocks J; ERS Global Lung Function Initiative. Multi-ethnic reference values for spirometry for the 3-95-yr age range: the global lung function 2012 equations. Eur Respir J. 2012 Dec;40(6):1324-43.
18. Spirometry monitoring technology. Centers for Disease Control and Prevention.
19. Vaz Fragoso CA, Van Ness PH, McAvay GJ. FEV1 as a standalone spirometric predictor and the attributable fraction for death in older persons. Respir Care. 2020 Feb;65(2):217–26.
20. Bhatti JS, Kumar S, Vijayan M, Bhatti GK, Reddy PH. Therapeutic strategies for mitochondrial dysfunction and oxidative stress in age-related metabolic disorders. Progress Molecular Biol Translational Sci. 2017;146(1): 13-46.

21. Mendrick DL, Diehl AM, Topor LS, Dietert RR, Will Y, La Merrill MA et al. Metabolic syndrome and associated diseases: from the bench to the clinic. Toxicological Sciences. 20 18;162(1):36-42.
22. Negm MF, Essawy TS, Mohammad OI, Gouda TM, EL-Badawy AM, Shahoot AG. The impact of metabolic syndrome on ventilatory pulmonary functions. Egyptian J Bronchol. 20 17;11(4):293-300.
23. Van Huisstede A, Cabezas MC, Birnie E, van de Geijn GJ, Rudolphus A, Mannaerts G et al. Systemic inflammation and lung function impairment in morbidly obese subjects with the metabolic syndrome. Journal of obesity. 20 13;2013:131349.
24. Kırdar S, Serter M, Ceylan E, Şener AG, Kavak T, Karadağ F. Adiponectin as a biomarker of systemic inflammatory response in smoker patients with stable and exacerbation phases of chronic obstructive pulmonary disease. Scandinavian J Clin Lab Investigat. 2009;69(2):219-24.
25. Chen WL, Wang CC, Wu LW, Kao TW, Chan JY, Chen YJ et al. Relationship between lung function and metabolic syndrome. PloS one. 2014;9(10):108989.
26. Bae MS, Han JH, Kim JH, Kim YJ, Lee KJ, Kwon KY. The relationship between metabolic syndrome and pulmonary function. Korean J Family Med. 2012;33(2):70-8.
27. Chaudhary SC, Kumari T, Usman K, Sawlani KK, Himanshu D, Gupta KK et al. Study of pulmonary function test abnormalities in metabolic syndrome. Journal of The Association of Physicians of India. 2018;66 (10):27-30.
28. Adeyeye OO, Ogbera OA, Dada AO, Bamisile RT, Mens A. Correlates of abnormal pulmonary function tests in persons with type 2 diabetes mellitus. J Pulm Respir Med. 2014; 5(1):231.
29. Yeh F, Dixon AE, Marion S, Schaefer C, Zhang Y, Best LG et al. Obesity in adults is associated with reduced lung function in metabolic syndrome and diabetes: the Strong Heart Study. Diabetes Care. 2011;34(10):230 6-13.