Iraqi New Medical Journal January 2017;3(1)

Effect of hypertension on pulmonary function tests: a cross sectional study from Baghdad

Haider Noori Dawood[1], Raad Taher Abdul Ghafour[2], Isra Taqi Abed[3]

[1] FIBM, FABM, FIBM (resp.). Chest physician at Al-Kandimia Teaching Hospital, Al-Karkh Health Directorate, Baghdad,Iraq.

[2] MSc Aviation Medicine. The National centre for Occupational Safety and Health,Baghdad,Iraq

[3] BSPh. The National centre for Occupational Safety and Health, Baghdad -Iraq

Corresponding Author:

Haider Noori Dawood. Al-Kandimia Teaching Hospital, Al-Karkh Health Directorate, Baghdad,Iraq. E mail: haider_noori2001@yahoo.com

ABSTRACT

INTRODUCTION: Hypertension has a major medical and public health issue worldwide. Several studies have shown an association between blood pressure and lung functions; however, many have denied such an association.

OBJECTIVE: The study was planned to assess the pulmonary function tests in patients with hypertension in comparison to healthy control persons.

METHODS: A cross sectional study has been conducted in the National Centre for Occupational Health and Safety, in Baghdad from May 2015 - May 2016. One hundred patients with hypertension have underwent pulmonary function tests. The following parameters FVC, FEV1, FEV1/FVC%, PEFR, FEF25, FEF50, and FEF75 were recorder and compared with those recorded from another 100 healthy non hypertensive patients. Patterns of abnormalities in both groups were also compared. Spirometry was performed in sitting posture. All participants were asked to perform 3 trails and best of the three readings were computed for analysis.

RESULTS: Eighty-six participants (86%) in each group have shown normal pulmonary function tests. Nine (9%) patients in hypertension group were having restrictive pattern and 5 (5%) had obstruction pattern. In control group 13 person had a restrictive pattern and only one person had an obstructive pattern. However, all these differences were statistically nonsignificant.

CONCLUSION: This analysis indicates that hypertension have no an adverse impact on pulmonary functions.

Key words: hypertension, spirometer, pulmonary function test.

Iraqi New Medical Journal January 2017;3(1)

INTRODUCTION

Hypertension is one of the commonest cardiovascular diseases, and blood pressure assumes more importance with increasing age.[1] The National High Blood Pressure Education Program reports that the global burden of hypertension is approximately 1 billion individuals and that more than 7 million deaths per year may be attributable to hypertension.[2] Hypertension is becoming an increasingly important public health challenge both in developing and developed countries,[3] and it is estimated that by 2025, up to 1.56 billion adults worldwide will be hypertensive.[4]

It has been proposed[5] that ischemic heart disease and hypertension in elderly can be independent risk factors for impairing pulmonary function tests even in the absence of any known lung diseases or history of smoking. Other studies have suggested that altered pulmonary function independently predicts cardiovascular events in persons with or without known coronary artery disease.[6,7] Some have suggested that hypertension and even its medical treatment have adverse effect on respiratory system.[8] On the other hand, Cohort studies have shown that people with lower measures of pulmonary function tests at baseline were consistently have a higher incidence of developing hypertension in the future.[9,10] Many variables like older age, higher mean systolic blood pressure and inflammation as measure by high hs-CRP are associated with reduced lung functions.[11,12]

Coronary Artery Risk Development in Young Adults (CARDIA) cohort study has shown that in an apparently healthy young person, a slight decline from the peak in the forced vital capacity to a low-normal level can facilitate the prediction of the development of arterial hypertension in the next 10 years.[13] Framingham Study

goes more extensive to suggest an inverse relationship between forced vital capacity (FVC) and cardiovascular diseases and mortality.[14] Some[15] have suggested that reduced pulmonary function is independently associated with aortic stiffness in men free of cardiovascular diseases.

Reduced lung function has been described as predictor of cardio-vascular disease (CVD) and mortality. Systemic low grade inflammation has been considered as a significant player in this association.[16] The cause of this relationship remains largely unknown, but low grade inflammation was present in participants with moderate and severe airflow obstruction and was also associated with increased risk of cardiac injury and this may in part explain the high rates of cardiovascular complications in chronic obstructive pulmonary disease (COPD).[17]

The argument about the effect of pulmonary functions on development of hypertension or the reverse have not been settled yet; in addition, there is no a solid and widely accepted explanation for why this relation, if it is present, is happening. Also inn published Iraqi literature that I have reached, I failed to find any trial to study this relation. So this cross sectional study tries to assess the effect of hypertension on pulmonary functions.

METHODS

Settings and type of the study: A cross sectional study was carried out in the National Centre for Occupational Health and Safety, in Baghdad from May 2015 - May 2016. 100 patients with history of Hypertension, their age group of 40-60 years were selected. National Centre for Occupational Health and Safety

Ethical issues: This study was approved by the scientific and ethical committees of research at Al-Karkh Health Directorate. All participants in this study have been informed about the aim of this study and their informed consent were taken before enrolment.

Case definition, Inclusion and Exclusion Criteria: We included any patient whose age is 40-60 years and visiting our centre for routine checkup were included in this study. Persons who refused to be enrolled in this study, those who have respiratory symptoms like cough and shortness of breath at time of the study, and those who have any history of chronic respiratory diseases or cardiovascular diseases other than hypertension were excluded from this study. Identification of the exclusion criteria were made through self-declaration by the person himself or through the clinical examination made during the interview.

Sampling: We chose our sample conveniently from those who visited our centre during our consultancy day; every Monday thought out the years. Mondays that happen to be a holiday is excluded.

Procedure: We included 100 patients with hypertension while other 100 persons who had no hypertension were taken as a control group. Data were extracted by direct interview to fill a questionnaire form prepared for this purpose by the authors. The data extracted were: age of the person, his gender, presence of any chronic medical illness, presence of any current respiratory symptoms, and history of smoking. Identification of chronic medical illness or current respiratory symptoms were made by self-declaration or through clinical examination conducted by experienced, independent chest physician. We considered any person who smoke any number of cigarettes at time of enrolment as being current smoker, those who quite completely and sustainable for more than 30 days as ex-smoker. Never smokers are those who did not smoke throughout their life. We measured the height of a participants up to nearest centimetre and the body weight up to the nearest kilograms then body mass index was calculated according to the formula BMI = weight in kilograms divided by height in meters squared.

Measurement of blood pressure for all participants were made by an independent physician by using a mercurial sphygmomanometer validated and calibrated recently. Measurement were taken while the participant in complete physical rest for at least 30 minutes in sitting position on the right completely bared arm.

All participants in both groups have underwent pulmonary function test we used Minispir, MR:125 Italy Machine in our study. The following parameters were measured for each person: Forced expiratory volume in 1 second (FEV1), forced vital capacity (FVC), the ratio of FEV1-to-FVC, force expiratory flow 25% (FEF25), force expiratory flow 50% (FEF50), force expiratory flow 75% (FEF75) and peaked expiratory flow rate (PEFR). Pulmonary function tests were done according to ATS /ERS guidelines.[18] The tests were performed the subject in a sit-

ting position and with nose clips in place. The participants performed at least three forced expiratory lung function manoeuvres and the best of them took. Before the tests the examiner demonstrated the correct performance of the manoeuvres and then the individuals were supervised throughout the tests.

According to the results of the pulmonary function test we grouped patients into three categories. Normal person if the pulmonary function test was completely normal. Obstructive pattern if the FEV1 was less than 80 % of the predicted. While we considered a person to have a restrictive pattern if FVC was lower than 80 % of the predicted. We realized that FVC is in accurate to define restrictive pattern of pulmonary function test as it is low in severe obstructive airways, and lung volumes are more sensitive to define restrictive pattern; however, measurement of lung volumes are not available in Baghdad at the time of the study also we did not come across severe obstructive lung diseases that could distort our results in this regard.

Statistical Analysis: The statistical analysis of this study was performed with the statistical package for social sciences (SPSS) 21.0 and Microsoft Excel 2013. Categorical data formulated as count and percentage. Chi-square test describe the association of these data. Numerical data with normal distribution were described as mean and standard deviation, independent sample t-test used in comparison between two groups. The lower levels of accepted statistical significant difference is bellow or equal to 0.05.

RESULTS

Table 1 summarizes the demographic features of participants in hypertensive and control groups. Age in control group was lower with a statistically significance 40.92±7.54 versus 47.26±10.20, While smoking status which is considered as an important confounding factor in our study has shown to be statistically non-significant between the two groups.

The following parameters: FVC, FEV1, FEV1/FVC%, PEFR, FEF25, FEF50, FEF75, FEF25-75, FEF0.2-1.2 have shown no statistical significance in both hypertensive and control groups with a P value > 0.05. See table 2

We found 14 participants in each hypertension and control group have an abnormal pulmonary function tests with no statistical significance. Types of abnormality whether obstructive or restrictive pattern in each group are seen in table 3. Difference in pattern of abnormality of pulmonary function tests in both groups have no statistical significance.

Table 1: The demographic characteristic of the hypertension and no hypertension groups

	Hypertension group	No hypertension group	p value
Age	47.26±10.20	40.92±7.54	<0.001**
Gender			
Male	89	86	0.335 NS
Female	11	14	
Smoking			
No	73	72	0.910 NS
Quit	6	5	
Yes	21	23	
BMI	30.94±6.09	29.60±6.94	0.148NS

NS: no statistical significant difference p>0.05.
** : Highly statistical significant difference (≤0.001)

DISCUSSION

Although we have a relatively small sample size to conclude some epidemiological figure about the demography of hypertension; however, we found that participants in hypertension group is relatively elder than those in control group with statistical significance. Also our sample have shown that men are more common to have hypertension than women though this

Table 2: Pulmonary function tests in both groups

	Hypertension group	No hypertension group	p value
FEV1	93.87±19.26	92.37±13.63	0.526 NS
FVC	92.92±14.17	92.53±14.59	0.848 NS
FEV1/FVC Ratio	99.04±8.89	100.20±7.23	0.313 NS
PERF	87.65±18.46	88.97±18.58	0.615 NS
FEF25	81.39±20.18	82.32±18.16	0.732 NS
FFEF50	88.78±28.56	86.99±24.07	0.632 NS
FE F75	89.82±40.94	91.07±33.81	0.814 NS

NS: no statistical significant difference p>0.05.

Table 3: Pattern of the results of pulmonary function test in both groups.

	Hypertension group (%)	No hypertension group (%)	P value
Obstructive	5 (5%)	1 (1%)	0.183 NS
Restrictive	9 (9%)	13 (13%)	
Normal	86 (86%)	86 (86%)	
Total	100	100	

NS: no statistical significant difference p>0.05.

difference did not reach to a statistically significant level, a result which has been also shown by Khoury[19] and Staessen.[20] We also found that body mass index was higher in hypertension group than no-hypertension group, however it was statistically nonsignificant. In contrast Humayun et al[21] has reported a statistically significant relation for BMI on hypertension. Having nonsignificant difference in gender and BMI in our sample can be explained by the fact that the number in each group was relatively small and the aim of the study was not to measure the demography of patient with hypertension but rather to find the presence of any abnormalities in pulmonary function tests in patients with hypertension.

Regarding the respiratory parameters; FEV1, FVC, FEV1/FVC%, PEFR, FEF25, FEF50, and FEF75, there were no statistically significant difference between the results of these parameters in patients with hypertension than persons in the control group ($p>0.05$). Jancy et al[22] has come to a similar result with regard to FEV1, Chen et al[23] on the other hand has reported that FEV1/FVC ratio has no statistical significance in patient with metabolic syndrome than in those without. Of course, high systolic or diastolic blood pressure is part of the metabolic syndrome. Many other studies have come to a different result, for example Schnabe et al[24] has stated that percentages of predicted FEV1 and FVC were significantly lower in persons with hypertension than in those without with p values of 0.01 for both. Schnabe[24] in his study has taken in consideration the type of anti-hypertensive medication used by the patients, the issue that we did not study in our sample. Shah et al[25] has also concluded that FVC, FEV1, FEV1/FVC%, PEFR, FEF25, FEF50, FEF75, and FEF25-75 were significantly lower in persons with hypertension compared to those without ($p<0.05$). Pramodh et al[26] has agreed to Swati Shah's conclusion for the following parameters FVC, FEV1, FEV1/ FVC and PEFR.

The explanation for the potential relation between pulmonary function and hypertension has been hypothesized by many studies.[27,28] It has been stated that chronic hypertension causes left ventricular dysfunction, and this results in increase left atrial pressure, which might lead to an increase in pulmonary artery pressure resulting into an interstitial oedema of the lungs causing a decrease in FEV1 and FVC values.[27] Other has suggested that the biomarkers of endothelial dysfunction and inflammation (fibrinogen, hs-C-reactive protein, soluble intracellular adhesion molecule-1, and interleukin-6), which usually explain the pathophysiological changes of cardiovascular diseases, probably cause a reduction in arterial elasticity and FVC particularly in men.[28] In addition some have linked the reduction of pulmonary function tests in hypertension to the effect of antihypertensive drugs.[24]

In our study, patients with hypertension and those without have shown a similar rate of having abnormalities in their pulmonary function test; 86 persons (86 %) for each, similarly distinction of abnormalities into obstruction and restrictive patterns has not shown a statistically significant difference between the two groups. This is inconsistent to Shah[25] who has reported that 74% of patients with hypertension have had an obstructive pattern, 13 % have had restrictive pattern and 13% have had normal pulmonary function tests. He explained this high rate of obstructive pattern among patient with hypertension to bronchoconstriction due to the use beta blockers even the cardio-selective ones. We unfortunately did not known the rate of using beta blockers in our sample.

The effect of hypertension on pulmonary function test may be due to the complication of the disease or the treatment rather than the disease itself. As showed by Paul et al study[29] in which the left ventricular mass was inversely related to FVC and FEV1 even after adjusting for age, gender, height, waist size, and BP. This relationship was governed primarily by left ventricular wall thickness, suggesting a contribution of altered left ventricular preload to the left ventricular mass/ pulmonary function relationship. Schnabe et al study[24] demonstrates that both high blood pressure and the use of beta blockers are associated with reduced lung function. Other antihypertensive drugs like thiazide diuretics, calcium channel blockers which have fewer effects on airway functions.[30]

Limitation of the study: Cross sectional study is intended to find a relation between exposure and outcome so in order to answer this research question cohort study may be a good choice; however, our limited resources refrained us for doing such a king of studies. This is also the same reason for having relatively small sample size and did not study the effect of other factors like duration of hypertension, its treatment and the state of control on the pulmonary function.

CONCLUSIONS

This study found that hypertension has no statistically significant effect of pulmonary functions. And it is not a predictor for determining the pattern of abnormal pulmonary functions once they occur.

REFERENCES

1. Opie LH and Seedat YK. Hypertension in sub-Saharan African populations. *Circulation* 2005;112(23):3562–3568.
2. Chobanian AV, Bakris GL, Black HR, Cushman WC, Green LA, Izzo JL Jr, and et al. Seventh report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure. *Hypertension* 2003;42(6):1206-1252.
3. Kearney PM, Whelton M, Reynolds K, Whelton PK, He J. Worldwide prevalence of hypertension: a systematic review. *J Hyperens* 2004; 22(1):11-19.
4. Kearney PM, Whelton M, Reynolds K, Muntner P, Whelton PK, and J. He. Global burden of hypertension: analysis of world wide data. *The Lancet* 2005;365(9455): 217–223.
5. Enright PL, Kronmal RA, Smith VE, Gardin JM, Schenker MB, Manolio TA. Reduced vital capacity in elderly persons with hypertension, coronary heart disease, or left ventricular hypertrophy. The Cardiovascular Health Study. *Chest* 1995;107(1):28–35.
6. Beaty TH, Cohen BH, Newill CA, Menkes HA, Diamond EL, Chen CJ.. Impaired pulmonary function as a risk factor for mortality. *Am J Epidemiol* 1982;116:102-13.
7. Sorlie PD, Kannel WB, O'Connor G. Mortality associated with respiratory function and symptoms in advanced age: the Framingham Study. *Am Rev Respir Dis* 1989;140:379-84.
8. Engström G, Hedblad B, Valind S and Janzon L. Increased incidence of myocardial infarction and stroke in hypertensive men with reduced lung function. *J of Hypertens* 2001;19:295-301.
9. Wu Y, Vollmer WM, Buist AS, Tsai R, Cen R, Wu X, and et al. Relationship between lung function and blood pressure in Chinese men and women of Beijing and Guangzhou: PRC-USA Cardiovascular and Cardiopulmonary Epidemiology Research Group. *Int J Epidemiol* 1998;27:49–56.
10. Engstrom G, Wollmer P, Valind S, Hedblad B, Janzon L. Blood pressure increase between 55 and 68 years of age is inversely related to lung function: longitudinal results from the cohort study 'Men born in 1914'. *J Hypertens* 2001;19:1203–1208.
11. Schnabel E, Nowak D, Brasche S, Wichmann HE, Heinrich J. Association between lung function, hypertension and blood pressure medication. Respir Med. 2011;105(5):727–33.
12. Lim SY, Rhee EJ, Sung KC. Metabolic syndrome, insulin resistance and systemic inflammation as risk factors for reduced lung function in Korean nonsmoking males. *J Korean Med Sci* 2010;25(10):1480–6.
13. Jacobs Jr, Yatsuya H, Hearst MO, Thyagarajan B, Kalhan R, Rosenberg S, and et al. Rate of Decline of Forced Vital Capacity Predicts Future Arterial Hypertension: The Coronary Artery Risk Development in Young Adults Study. *Hypertension* 2012; 59:219–225.
14. Kannel WB, Hubert H, Lew EA. Vital capacity as a predictor of cardiovascular disease: the Framingham study. *Am Heart J* 1983;105:311-5.
15. Mahmoud Z, Athanase B, Catherine N, et al. Reduced Pulmonary Function Is Associated with Central Arterial Stiffness in Men. *Am J Respir Crit Care Med* 2001;164:2181–2185.
16. Hwa M, Steven T, Nathan D. Evidence of Lung Function for Stratification of Cardiovascular Disease Risk. *Korean Circ J* 2011; 41(4):171–174.
17. Sin DD, Man SF. Why are patients with chronic obstructive pulmonary disease at increased risk of cardiovascular disease? The potential role of systemic inflammation in chronic obstructive pulmonary disease. *Circulation* 2003;107:1514–1519.
18. Miller MR, Hankinson J, Brusasco V, Burgos F, Casaburi R, Coates A, et al. Standardization of spirometry. *Eur Respir J* 2005;26:319-38.
19. Khoury S, Yarows SA, O'Brien TK, Sowers JR. Ambulatory blood pressure monitoring in a nonacademic setting: effects of age and sex. *Am J Hypertens* 1992;5:616–623.
20. Staessen J, Fagard R, Lijnen P, Thijs L, Van Hoof R, Amery A. Reference values for ambulatory blood pressure: a meta-analysis. *J Hypertens* 1990;8(suppl 6):S57–S64.
21. Humayun A, Shah AS, Sultana R. Relation of hypertension with body mass index and age in male and female population of Peshawar, Pakistan. *J Ayub Med Coll Abbottabad* 2009;21(3):63-5.
22. Jeya Jancy A, Selvi Ratnam. A Study to Evaluate the Effect of Hypertension on Lung Function Parameters in South Indian Population. *Indian Journal of Research* 2016; 5: 59-60.
23. Chen W-L, Wang C-C, Wu L-W, Kao T-W, Chan JY-H, Chen Y-J, Yang YH, Chang YW, Peng TC. Relationship between Lung Function and Metabolic Syndrome. *PLoS ONE* 2014;9(10):e108989. doi:10.1371/journal.pone.0108989.
24. Schnabel E, Karrasch S, Schulz H, Gläser S, Meisinger C, Heier M, and et al. High blood pressure, antihypertensive medication and lung function in a general adult population. *Respiratory Research* 2011, 12:50. doi: 10.1186/1465-9921-12-50.
25. Shah S, Shaikh M, Gupta Y, Nahar P, Zingade U, Kowale A. Pulmonary Function Tests in Hypertension. *International Journal of Pharma Sciences and Research (IJPSR)* 2014;5(7): 338-343.
26. Pramodh V., Bhanu R. Pulmonary Function Tests in Hypertensive Patients. *Journal of Dental and Medical Sciences (IOSR-JDMS)* 2015; 14(10) Ver XI: 06-09.
27. Wu Y, Vollmer WM, Buist AS, Tsai R, Cen R, Wu X, and et al. Relationship between lung function and blood pressure in Chinese men and women of Beijing and Guangzhou. *Int J of Epidem* 1998; 27(1): 49-56.
28. Duprez DA, Hearst MO, Lutsey PL, Herrington DM, Ouyang P, Barr RG, et al. Associations Among Lung Function, Arterial Elasticity, and Circulating Endothelial and Inflammation Markers: The Multiethnic Study of Atherosclerosis. *Hypertension* 2013; 61 (2):542-548.
29. Enright PL, Kronmal R A , Smith V-E, Gardin JM, Schenker MB, Manolio TA. Reduced Vital Capacity in Elderly Persons With Hypertension, Coronary Heart Disease, or Left Ventricular Hypertrophy* The Cardiovascular Health Study. *Chest* 1995;107(1): 28-35.
30. Gracia-Rio F, Miravitlles M, Soriano JB, Muñoz L, Duran-Tauleria E, Sánchez G et al, EPI-SCAN Steering Committee. Systemic inflammation in chronic obstructive pulmonary disease: a population-based study. *Respiratory Research* 2010;11(1):63. doi:10.1186/1465-9921-11-63.

Abbreviation list: American Thoracic Society/ European Respiratory Society (ATC/ERS), Body Mass Index (BMI), Cardio-Vascular Diseases (CVD), Chronic Obstructive Pulmonary Disease (COPD), Coronary Artery Risk Development in Young Adults (CARDIA), Forced Expiratory Volume in 1 Second (FEV1), Forced Vital Capacity (FVC), Force Expiratory Flow 25% (FEF25), Force Expiratory Flow 50% (FEF50), Force Expiratory Flow 75% (FEF75), High Sensitivity C Reactive Protein (hs-CRP), Nonsignificant (NS), Peaked Expiratory Flow Rate (PEFR), Ratio of FEV1-to-FVC (FEV1/FVC %), Statistical Package For Social Sciences (SPSS)

Conflict of interest: Authors have nothing to declare.

Funding: Authors received no funds to complete this study a part from self funding.