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Pulmonary Function Tests In Hypertensive Versus Normotensive Subjects With Or Without Obesity: A Comparative Study

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Abstract

Background: Hypertension is an important public health challenge worldwide. In India hypertension is found to be directly responsible for 57% of all stroke deaths, 24% of all coronary heart diseases and 10% of all deaths[14]. Hypertension is also closely related to obesity. Obesity can lead to multiple co morbid conditions like diabetes, cardiovascular diseases, etc[6]. Hypertensive Patients exhibits lower pulmonary function test values. Form the study of Bai J et al., (1998)[2] concluded that obese people are at increased risk of respiratory system such as breathlessness.

Aims & Objective: To study pulmonary function tests in hypertensive, obese and non obese subjects and compare them.

Methods: The present one year study was undertaken in the Post Graduate Department of Physiology in Government Medical College and Hospital, Jammu after approval from ethical Committee No. TFC/GMC/2019/782 dated 06/12/2019 IEC Pharma Thesis research 2018/5931. On two hundred subjects, were selected from patients attending the medicine OPD of Govt. Medical College and Hospital Jammu and who volunteered for the study.

Hypertensive subjects were selected based on following criteria's

Inclusion Criteria: HT for more than 5 years but less than 10 years.

Avg Systolic pressure ≥ 140mm Hg but ≤ 180mm Hg.

Avg Diastolic pressure ≥ 90mm Hg but ≤ 104mm Hg.

Age between 35-65 years of age.

Normotensive subjects were selected with avg SBP ≤ 120mm Hg and DBP ≤ 80mm Hg.

Exclusion Criteria: Smoker and tobacco users, history of any lung diseases (restrictive or obstructive), deformities of chest wall or spine, Diabetics, those with severe communicable lung infections like, tuberculosis, patients with cardiovascular disease other than hypertension.

Conclusion: FVC showed a significant decrease in the hypertensive obese, hypertensive non obese and normotensive obese groups of all the groups, the most significant decrease in FVC was seen in the Hypertensive obese group.

1. FEV_1 significant decrease in Hypertensive obese, Hypertensive Non-Obese and Normotensive obese group. Of all the groups, the most significant decrease in FVC was seen in the Hypertensive obese group.
2. FEV_1/FVC ratio was high in hypertensive group followed by Normotensive Non-obese, Normotensive Obese, Hypertensive Non Obese and the difference seen among the groups was significant.

PEFR significant decrease in all the groups when compared to the Normotesive non Obese group but the difference among the Hypertensive-obese, Hypertensive Non obese and Normotesive obese was insignificant.

Keywords: Pulmonary Function test, Obesity, Hypertension

Introduction

Hypertension is an important public health challenges worldwide[7]. It is the major cause of heart diseases, stroke and kidney failure, premature mortality and disability. It usually affects the low and middle income countries populations, where health system is weak[22]. Hypertension is also closely related to obesity. Obesity can lead to multiple co-morbid conditions like diabetes, cardiovascular diseases etc[6]. Obesity is emerging as a global epidemic in both children and adults this is called "New world syndrome". Obesity is a complex disease because it arises from multifaceted interactions of genetic and environmental factors[11]. Subjects with excessive body weight tend to have reduced cardiopulmonary fitness and chronically hypo-ventialted[15].

There is substantial increase in morbidity and mortality in obese hypertensive in comparison to obese normotensive and healthy individuals. Beaty TH et al., (1982)[2] in a number of studies have identified altered pulmonary function as an independent risk factor for adverse cardiovascular outcome. Strachman DP et al., (1982)[20]suggested that altered pulmonary function independently predicts cardiovascular events in persons both with and without known coronary heart disease.

Materials And Methods

The present comparative study was undertaken in the Post Graduate Department of Physiology, Government Medical College and Hospital, Jammu w.e.f Nov 2018 to Oct 2019 on 200 subjects, both males and females with age ranging between 35 and 65 years. Subjects were selected randomly from patients attending the Medicine OPD of Government Medical College and Hospital, Jammu and who volunteered for the study. Detailed explanation of the purpose and methodology of tests was provided to all subjects. After obtaining detailed history of the subjects, patients were examined in Post graduate department of physiology for various physical parameters. Hypertensive subjects were selected on the basis of Inclusion and Exclusion criteria's categorization of subjects into four groups.

1. Group I- Normotensive Obese subjects (50)
2. Group II- Hypertensive Obese subjects (50)
3. Group III- Hypertensive Non-obese subjects (50)
4. Group IV- Normotensive Non-obese subjects (50)

Anthropometric and other physical measurements; Age, Body weight, Height, BMI[21] (Body Mass Index)

BMI $\frac{Weight\ (Kg)}{Height\ (m^2)}$

BP measured using sphygmomanometer[8]

Grading of BMI[4].

BMI < 18.5 underweight

BMI- 25-29.9 overweight

BMI > 30 obese

Pulmonary Function tests are done using computerized spirometer (Medspiror) DT spiro and all the test were done according to American Thoracic Society/ European Respiratory Society (ATS/ETS) in quiet room in sitting position. Three reading were taken and best one is considered. PFT readings of the subjects were considered acceptable only if they met the acceptable criteria laid down by Miller MR et al., (2005)[12]. Only one manoeuvre is FVC was required to accumulate all the necessary data.

FVC test: The subjects were asked to exhale through the mouth piece with full force after forceful inspiration. After the manoeuvre was completed, a long beep confirmed the completion of tests. Four most important parameters i.e. FVC, FEV1, FEV1/FVC and PEFR were displayed on LCD along with predicted value and actual value.

Statistical Analysis: data was presented in Excel Sheet, one way ANOVA test applied followed by

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post hoc analysis using bonferroni correction, p-values <0.05 were considered significant.

Result

The Difference in the mean age of different group is non-significant (p=0.141). The group I and II have significantly higher BMI as compared to group III (p<0.001) and IV (p<0.001) and group-II (p<0.001). Whereas difference is non-significant between group I & II (p=0.104) and between group III & IV (p=0.99). The systolic blood pressure (SBP) and diastolic blood pressure (DBP) recorded shows significant difference between groups I & II (p<0.001) and III & IV (p<0.001), whereas it is non-significant between group I & IV (SBP p=0.55) (DBP p=1.00) and group II & III (SBP p=0.24) (DBP p=0.611).

Table 1: Distribution of anthropometric parameters of enrolled patient.

Variable	Study Groups						Inter Group p-value					
	Group-I	Group-II	Group-III	Group-IV	F-value	p-value						
	Obese NT N=50 Mean± SD	Obese HT N=50 Mean±SD	Non Obese HT N=50 Mean±SD	Non Obese NT N=50 Mean±SD			Group-III vs Group-IV	Group-I vs Group – IV	Group-II vs Group-IV	Group-I vs Group-III	Group-II vs Group-III	Group-I vs Group-II
Age (years)	45.72 ± 7.82	46.00±7.03	48.7±7.33	46.00±7.03	1.84	0.1410	0.39	1.00	1.00	0.25	0.39	1.00
Height (cms)	158.32±8.19	155.06±5.71	159.54±12.90	159.54±12.89	-	0.000	1.00	0.936	0.140	0.936	0.140	0.399
Weight (Kgs)	83.63±10.40	81.51±10.97	57.78±11.19	57.58±11.15	-	0.000	1.00	0.000	0.000	0.000	0.000	0.399
BMI	33.46±2.16	34.43±2.85	22.48±1.66	22.400±1.61	488.07	0.000	0.998	0.000	0.000	0.000	0.000	0.104
SBP	116.96±7.34	151.20±10.62	154.60±11.64	114.56±5.38	269.86	0.000	0.000	0.552	0.000	0.000	0.245	0.000
DBP	75.90±6.31	95.62±14.19	97.76±4.89	75.90±6.31	99.36	0.000	0.000	1.000	0.000	0.000	0.611	0.000

Table 2: Distribution of mean FVC values among different groups (Hypertensive Obese, Hypertensive Non obese, Normotensive obese & Normotensive Non obese).

Groups	N	Mean	Std. Deviation	95% Confidence Interval for Mean	
				Lower Bound	Upper Bound

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FVC	NT Obese (Group-I)	50	3.3458	.57428	3.1826	3.5090
	HT-Obese (Group-II)	50	2.5262	.20073	2.4692	2.5832
	HT-Non obese (Group-III)	50	3.0756	.58514	2.9093	3.2419
	NT-Non obese (Group-IV)	50	4.5174	.57933	4.3528	4.6820
	Total	200	3.3663	.88863	3.2423	3.4902

The lowest mean FVC was observed in ht-Obese group (2.5262±0.20073) whereas maximum FVC value was seen in NT-Non obese (group-IV) (4.5174±0.57933).

Table 3: Distribution of mean FEV1 values among different groups (Hypertensive obese, Hypertensive Non obese, Normotensive obese & Normotensive Non obese).

Groups		N	Mean	Std. Deviation	95% Confidence Interval for Mean	
					Lower Bound	Upper Bound
FEV1	NT Obese (Group-I)	50	2.8688	.52714	2.7190	3.0186
	HTN-Obese (Group-II)	50	2.3324	.15133	2.2894	2.3754
	HTN-Non obese (Group-III)	50	2.5132	.54930	2.3571	2.6693
	NT-Non obese (Group-IV)	50	4.0978	.58805	3.9307	4.2649
	Total	200	2.9531	.84258	2.8356	3.0705

The mean of FEV1 level among group Normotensive Non-obese as 4.09± 0.58 which is higher than the other groups.

Table 4: Distribution of mean FEV1/FVC values among different groups (Hypertensive Obese, Hypertensive Non obese, Normotensive obese & Normotensive Non obese)

Groups		N	Mean	Std. Deviation	95% Confidence Interval for Mean	
					Lower Bound	Upper Bound
FEV1/ FVC	NT Obese (Group-I)	50	85.1132	8.36182	82.7368	87.4896
	HTN-Obese (Group-II)	50	92.5516	4.63034	91.2357	93.8675
	HTN-Non obese (Group-III)	50	82.2726	10.14129	79.3905	85.1547
	NT-Non obese (Group-IV)	50	90.9746	6.55582	89.1115	92.8377
	Total	200	87.7280	8.72308	86.5117	88.9443

The mean percentage of FEV1/FVC level among Hypertensive-obese group as 92.55±4.63 which is higher than the other groups.

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Table 5: Distribution of mean PEFR values among different groups (Hypertensive Obese, Hypertensive Non obese, Normotensive obese & Normotensive Non obese).

Groups		N	Mean	Std. Deviation	95% Confidence Interval for Mean	
					Lower Bound	Upper Bound
FEV1/ FVC	NT Obese (Group-I)	50	6.1004	1.19068	5.7620	6.4388
	HTN-Obese (Group-II)	50	6.0554	1.13026	5.7342	6.3766
	HTN-Non obese (Group-III)	50	5.3522	O.82949	5.1165	5.5879
	NT-Non obese (Group-IV)	50	8.6754	1.90060	8.1353	9.2155
	Total	200	6.5459	1.82490	6.2914	6.8003

PEFR level AMONG Normotensive-Non obese group as 8.67 ± 1.90 which is higher than the other groups.

Table 6: Distribution of spirometry parameters among different groups

Variable	Study Groups				F-value	p-value	Inter Group p-value				
	Group-I	Group-II	Group-III	Group-IV							
	NT Obese N=50 Mean±SD	HT Obese N=50 Mean±SD	HT Non Obese N=50 Mean±SD	NT Non Obese N=50 Mean±SD			Group-III vs Group-IV	Group-I vs Group –IV	Group-I vs Group-III	Group-II vs Group-III	Group-I vs Group-II
FVC (1)	3.35±0.57	2.52±0.20	3.08±0.59	4.52±0.58	134.58	0.000	0.000	0.000	0.054	0.000	0.000
FEV1(I)	2.87±0.53	2.33±0.15	2.51±0.55	4.10±0.59	133.31	0.000	0.000	0.000	0.002	0.250	0.000
FEVI/FVC (%)	85.11±8.36	92.55±4.63	82.27±10.14	90.97±6.56	19.79	0.000	0.000	0.001	0.256	0.000	0.000
PEFR (I)	6.10±1.19	6.06±1.13	5.35±0.83	8.68±1.90	60.98	0.000	0.000	0.000	0.026	0.042	0.998

Table 7: Correlation of FVC with various pulmonary function parameters (FEV1, FEV1/FVC and PEFR)

Correlation	FEV1(I)	FEV1/FVC (%)	PEFR(I)
FVC	0929	-0.0005	-0.6369

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P value	<0.001	0.993	<0.001
N	200	200	200

Table 8: Correlation of FEV1 with various pulmonary function parameters (FVC, FEV1/FVC and PEFR)

Correlation	FVC(L)	FEV1/FVC (%)	PEFR(I)
FEV1	0.9291	0.3212	0.7026
P value	<0.001	<0.001	<0.001
N	200	200	200

Table 9: Correlation of FEV1/FVC with pulmonary function parameters (FVC, FEV1/FVC and PEFR)

Correlation	FVC(L)	FEV1 (I)	PEFR (I)
FEV1/FVC	-0.005	0.3212	0.2991
P value	0.9939	<0.001	<0.001
N	200	200	200

Table 10: Correlation of PEFR with pulmonary function parameters (FVC, FEV1, FEV1/FVC)

Correlation	FVC (L)	FEV1(I)	FEV1/FVC (%)
PEFR	0.6369	0.7026	0.2991
P value	<0.001	<0.001	<0.001
N	200	200	200

Discussion

The physical parameters like age,gender,weight, height and blood pressure were recorded for all the enrolled patients and PFTs including lung volumes, capacities and flow rates were recorded. The physiological factors influence the target parameters. The difference of mean age between various groups is not statistically significant. Significant difference was seen among groups for measured parameters viz FVC, FEV1, FEV1/FVC ratio and PEFR. FVC is most important PFT which is very sensitive to diseases that effect lung elasticity and its mechanical properties[9]. FEV1 and FEV1/FVC ratio are important in detection of obstructive type of pulmonary impairment. PEFR reflects exhalatory strength of lungs and can be used as alternative test to assess the overall condition of lungs. There was a significant reduction of FVC, FEV1 and PEFR measures in all the study groups when compared to control group. (Non obese and Normotensive group). FVC in all the study groups have shown significant reduction, but the reduction is greater in obese and hypertensive group which reflects that they have negative impact on FVC. Obese Normotensive and Non Obese hypertensive group have almost similar means values for FVC, although reduced in comparison to control group. FEV1 and PEFR in all the study group as reduced in comparisons to control group. Mean value of FEV1 and PEFR was least for group comprising of both obese and hypertensive patients. This reflects that obesity and hypertension comprise lung performance. Our results are in agreement to similar studies [19]summarized that these are a negative correlation between obesity and lung function test.

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In all groups in our study the FEV1/FVC ratio was higher than cut-off of 70% which suggests a restrictive pulmonary condition. It was similar to the previous workers who had reported restrictive ventilator defect in obesity[13,10] in our study the increased BMI has positive correlation with FEV1/FVC and negative correlation with FVC, FEV1 and PEFR.

Similar [3]results showed significant positive correlation of BMI with FEV1/FVC and negative correlation of FEV1 with BMI in our Hypertension has statistically significant negative co-relation with PFTS, Similar to studies [5] showed that the incidence of cardiovascular disease and mortality associated with hypertension is increased in patients with compromised lung function. [16]concluded that there was decrease in FVC and FEVI in patients of hypertension studies [18],[17] significant association between FVC and incidence of hypertension seen.

Summary And Conclusion

Results suggest that there is significant decrease in the various PFT's parameters in hypertensive and obese individuals but decrease in PFTs parameters were more significant in the obese group of individuals when compared to other groups. The literature indicates decrease in chest wall compliance in obesity is due to increased amount of adipose tissue around the chest wall and abdomen. Obesity increases the risk of development of hypertension both these have adverse effect on PFT.

Following conclusions were drawn:-

Significant decreases in PFT parameters like FVC, FEV^1 and significant increase in FEV^1/FVC ratio among hypertensive obese individuals indicates a restrictive pulmonary disease.

Both obesity and HT have negative impact on PFT while obesity has greater impact on reduction in PFR than HT. The negative correlation of respiratory parameters like FVC and FEV1 with BMI and hypertension could further predispose them to increased respiratory and cardiovascular risk.

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