Original Article

Measurement of Blood Pressure as Cardiovascular Risk in Stable COPD Patients

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Abstract

COPD is one of the major cause of chronic morbidity and mortality throughout the world. Among the extra pulmonary effects of COPD cardiovascular disorders are significant. Although its silent involvement is known, but little attention paid to this major comorbidity while treating these group of patients. To assess the cardiovascular risk even in stable COPD patients their systolic blood pressure (SBP), diastolic blood pressure (DBP), pulse pressure (PP), mean arterial pressure (MAP) were observed and correlated these with the severity of airflow limitation (FEV_1). This cross-sectional study was carried out in the Department of Physiology, Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka from January to December, 2010. For this purpose 60 (sixty) male, smoker (5-10 pack year) patients of stable COPD (FEV_1/FVC% <0.70; FEV_1≤80%; without any exacerbation for last 4 weeks) were randomly selected from the Out Patient Department (OPD) of the Cardiovascular unit of the Department of Cardiology, BSMMU and also from a private clinic in Dhaka. On the basis of spirometric findings, 30 mild (group B_1) and 30 moderate stages (group B_2) of COPD patients with age 35-45 years were included in this study. In addition, 30 age, BMI, serum lipid profile and smoking status matched apparently healthy male persons were studied as control (group A). SBP, DBP, PP and MAP (by sphygmomanometer and stethoscope) were measured and calculated. Data were expressed as mean±SD. For statistical analysis Independent sample t-test and Pearson's Correlation Coefficient test were performed, as applicable and $p<0.05$ was accepted as significant. Significantly ($p<0.001$) higher SBP, DBP, PP and MAP were found in moderate stage (group B_2) than those of control and mild stage (group B_1) of COPD patients. In addition, 4 types of BP were negatively correlated with FEV_1 in moderate stage and were statistically significant for SBP ($p<0.01$), PP and MAP ($p<0.05$). This study reveals that, cardiovascular function status may be altered even in stable COPD and this alteration is inversely related to the severity of the disease.

Key words: SBP, DBP, PP, MAP, COPD

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Introduction

COPD is a preventable and treatable disease, but once developed, this disease along with its comorbidities can not be cured totally. However, its progression and consequences can be reduced.[1] Many people suffer from this morbid disease for years and die too early from its complications. It is the fourth leading cause of death in adults of USA & also projected to be the third by 2020.[2-4] COPD is becoming a rising burden for both developed and developing countries day by day. This upsurge of the morbidity is thought to be due to urbanization, industrialization and change of profession of people from 'agriculture and fresh air' based rural communities to industry and smoking based urban settings in our country. Total burden of COPD patients in Bangladeshi population is about 6 million now.[5] The pulmonary component of COPD is characterized by airflow limitation which is usually progressive and not fully reversible. Along with the pulmonary changes it also has various extrapulmonary (systemic) effects, such as raised circulatory inflammatory markers (like CRP) and polycythemia.[6] These systemic effects may lead to different comorbid conditions, such as ischemic heart disease and cardiac failure.[6-8] It has been proposed that about 50% death in COPD patients may result from cardiovascular cause rather than pulmonary cause itself. [9] In addition, the cardiovascular risk has been reported to be independent of the effects of smoking and other factors like physical fitness, aging process, life style

etc in this group of patients.[10] However, airflow limitation and persistent low grade systemic inflammation may increase the cardiovascular risk in patients with COPD[3].

Findings of some recent studies suggested that COPD itself is an important risk factor for different manifestations of cardiovascular diseases.[11-13] Within these, increased systolic blood pressure (SBP) or isolated systolic hypertension has been proposed to be a direct risk factor of coronary heart disease in COPD patients.[14] As the SBP is mainly influenced by stiffness of large arteries and left ventricular ejection pattern.[15] Many investigators of different countries reported higher values of SBP in patients with COPD.[2,11,13,16,17] In addition, DBP that is largely determined by peripheral arterial resistance and increases until middle age and then tends to fall in contrast to SBP.[15] Higher values of DBP and MAP in COPD patients were also reported by different researchers.[13] Again, increased pulse pressure (PP) is one of the major cardiovascular risk factor with advancing age[14,18,19]. Higher values of pulse pressure in COPD patients was reported by various researchers of different countries.[2,11,13] Many investigators of different countries measured different types of BP in patients with COPD and reported higher values. With the best of our knowledge various researchers studied several aspects of COPD in our country, but no reported data yet available to document the changes in SBP, DBP, PP and MAP of this group of patients. Therefore, this study was carried out to assess different types of BP as cardiovascular risk factors in male patients with stable COPD.

This study may signify the importance of screening for higher SBP, DBP, PP and MAP in order to minimize the risk for cardiovascular comorbidity in this group of patients. In addition, the outcome of this study may act as a source of background information in creating awareness to the clinicians about the cardiovascular involvement in COPD patients.

Materials & Methods

For this study, 60 male, smoker patients of stable COPD (without any exacerbation for last 4 weeks[12]) were randomly selected from the out patient door of Cardiovascular unit of Department of Cardiology, BSMMU and also from a private clinic in Dhaka. On the basis of spirometric staging, all the patients were divided into mild (group B_1) ($FEV_1 \geq 80\%$ of predicted; n=30) and moderate (group B_2) ($FEV_1 < 80\%$ but $\geq 50\%$ of predicted[5]; n=30) stage of COPD. For comparison, 30 age (35 to 45 years), BMI (24.7 to 25.6 kg/m^2), serum lipid profile (cholesterol: 150 to 200 mg%; TG: 50 to 150 mg%; HDL: >40 mg%; LDL: <150 mg%[20]) and smoking status (5 to 10 pack years[21]) matched apparently healthy male persons as control (group A) were randomly selected from the community. Any subject with diabetes mellitus (Fasting plasma glucose >7 mmol/dl[22]), systemic hypertension (SBP $\geq$ 140 and DBP $\geq$ 90 mm of Hg[23]) before the diagnosis of COPD, with any pulmonary comorbidity (e.g, bronchiectasis, pulmonary fibrosis, pneumonectomy, lobectomy) or any other systemic disease (e.g, rheumatoid arthiritis, connective tissue disorder), treatment with long term steroid or theophylline or any immunosuppressive therapy or with history of any heart disease, were excluded from the study.[13] After selection, all the subjects were thoroughly informed about the aim, benefit and procedure of the study and were encouraged for voluntary participation. After their agreement an informed written consent was taken from them and was requested to attend the Department of Physiology at 7.30 am in a fasting state on the day of examination. In addition, all of them were also instructed to abstain from tea, coffee or any type of smoking for at least 12 hours before that very day. At the examination day, their detailed personal, medical and drug history were taken and thorough physical examinations were done. All informations were recorded in a pre-fixed questionnaire. Then with all aseptic precautions 5 ml of venous blood was collected from left ante-cubital vein to measure the serum lipid profiles and glucose. Cardiovascular status of all subjects was assessed by measuring SBP, DBP (by sphygmomanometer and stethoscope) and calculating PP and MAP.

All the data were expressed as mean±SD. For statistical analysis, Independent samples t-test and Pearson's Correlation Coefficient test were performed by using SPSS for windows version-12, as applicable and $p<0.05$ was accepted as significant.

Results

Age and BMI were matched in all groups, as shown in Table I.

Table-I: Baseline characteristics in different groups (n=90)

Groups	Age (years)	BMI (Kg/m^2)
A	47.1±5.29	25.6±2.24
(n=30)	(37-55)	(21-30)
B_1	47.2±6.04	25.0±2.37 *
(n=30)	(35-55)	(21-30)
B_2	47.7±5.32	24.7±3.13$^{\dagger\#}$
(n=30)	(35-55)	(19-32)

A = apparently healthy subjects (Control)
B_1 = COPD patients (mild stage)
B_2 = COPD patients (moderate stage)
A vs B_1 = $^{**,\dagger,\#}$ = non significant
A vs B_2 = †
B_1 vs B_2 = $^{\#}$

Mean SBP, DBP, PP and MAP were higher in both the study groups to that of the control. However, these differences were statistically significant only in group B_2

(p<0.001) in comparison to those of control and mild stage of COPD (Table II).

Table -II: Mean±SD of SBP, DBP, PP and MAP in different groups (n=90)

Groups	SBP (mm of Hg)	DBP	PP	MAP
A (n= 30)	118.2±8.25 (100-130)	76.3±5.56 (70-85)	41.8±5.49 (30-50)	90.3±6.05 (80-100)
B_1 (n=30)	120.7±6.91* (110-130)	78.5±4.38* (70-85)	42.2±4.49* (35-50)	92.6±4.93* (83-100)
B_2 (n=30)	128.8±8.78$^{\dagger\dagger\#\#\#\#}$ (120-145)	81.3±5.56$^{\dagger\dagger\#\#}$ (70-90)	47.5±6.26$^{\dagger\dagger\#\#\#\#}$ (40-60)	97.2±6.13$^{\dagger\dagger\#\#\#}$ (87-108)

A = apparently healthy subjects (Control)
B_1 = COPD patients (mild stage)
B_2 = COPD patients (moderate stage)
A vs B_1 = $^{**, \dagger, \#}$ = non significant $^{**, \dagger\dagger, \#\#}$ = Significance at p 0.05
A vs B_2 = † $^{***, \dagger\dagger\dagger, \#\#\#}$ = Significance at p 0.01
B_1 vs B_2= $^{\#}$ $^{****, \dagger\dagger\dagger\dagger, \#\#\#\#}$ = Significance at p 0.001

Moreover, in group B_2, 23(77%) and 20(66.7%) patients were with increased values of SBP and PP respectively (Table III; Figure 1).

Table -III: Frequency distribution of the subjects by increased SBP and PP in different groups (n= 90)

	Group A		Group B_1		Group B_2	
	Normal	Increased	Normal	Increased	Normal	Increased
Variables	No. (%)		No. (%)		No. (%)	
SBP	30 (100%)	0 (0%)	30 (100%)	0 (0%)	7(23%)	23(77%)
PP	19 (63.3%)	11(36.7%)	19 (63.3%)	11 (36.7%)	10(33.3%)	20 (66.7%)

A = apparently healthy subjects (Control)
B_1 = COPD patients (mild stage)
B_2 = COPD patients (moderate stage)
Cut point for increased SBP 140mm of Hg[23]
Cut point for increased PP > 40mm of Hg[23]

Figure-I: Frequency distribution of the subjects by increased SBP and PP in moderate stage (group B_2) of COPD (n=30) Cut point for increased SBP 140 and PP 40mm of Hg[23]

Furthermore, SBP, DBP, PP and MAP were negatively correlated with FEV_1 in patients of both groups (B_1 and B_2). Except for DBP all these relationships were statistically significant (p<0.01) for SBP and (p<0.05) for PP, MAP in group B_2 (Figure: II).

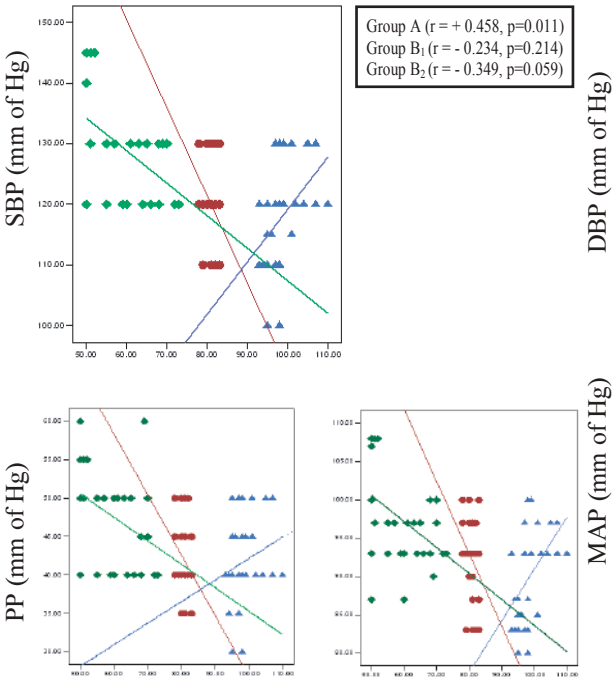

Figure- II:Correlation of SBP, DBP, PP and MAP with FEV1 in different groups (n=90)

A = apparently healthy subjects (Control)
B_1 = COPD patients (mild stage)
B_2 = COPD patients (moderate stage)

Discussion

In this study, findings of all the variables in healthy control group were within the normal range and also similar to those of the observations of various investigators of different countries abroad as well as of our country.[2,4,11,13,24] . Here, mean SBP, DBP, PP and MAP were significantly higher only in the moderate to those of the control and mild stage of COPD patients. These findings were in agreement with some other researchers abroad.[2,3,13,16] Moreover, SBP, PP and MAP were negatively correlated with FEV_1 (variable of airflow limitation) in both the study groups, though the relationship was statistically significant only in moderate stage of COPD except for DBP. This finding was in agreement with several researchers of different countries.[2,11,13] Although, several mechanisms regarding the changes in cardiovascular function of COPD patients have been proposed by many investigators of different countries abroad.[1,3,25,26] But the exact mechanism of these changes in our study have not been clearly delineated yet.

It has been suggested by a group of researchers abroad that the chronic airflow limitation in the COPD patients might be the causative factor for the development of chronic hypoxia.[1] As a consequence there may be vasoconstriction in pulmonary circulation of this group of patients. This increment of pulmonary vascular resistance may increases the right ventricular workload.

In addition, it has also been reported that persistent low grade systemic inflammation in patients with COPD may cause excessive neutrophil elastase activity that resulting consumption of elastic fibers in the tunica media of large arteries. As a consequence there may be development of arterial stiffness (rigidity of vessel wall).[26]Another group of researchers abroad proposed that elastin (core portion of elastic fiber) might be involved in the regulation of vascular smooth muscle cell functions in COPD patients. As the elastin consumed, so there may be vascular smooth muscle cell dysfunction which may contribute to the development of arterial stiffness.[27] So, increased SBP and PP in COPD patients of the present study might be due to increased arterial stiffness from any of the above mentioned causes.

Increased arterial stiffness in COPD patients augments pulse pressure, left ventricular after load and myocardial oxygen demand but at the same time decreases vascular compliance, coronary circulation resulting ischemic heart disease.[28] In addition to these, increased left ventricular after load promotes left ventricular hypertrophy, a recognized cardiovascular risk factor.[29] Again, it has been reported by a group of researchers that there is also left ventricular diastolic dysfunction in patients with COPD.[17] Thus COPD is associated with 2 to 3 fold increase in the risk of ischemic heart disease, stroke and sudden death.[13] From this study, it may be concluded that the cardiovascular function status alter in stable COPD patients as evidenced by increased all types of BP and that are inversely related to the severity of airflow limitation.

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