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A Study Of Endothelial Dysfunction In Diabetic Patients In Rural India

Pijush Kanti Mandal[1], Arpan Kumar Dey, Subhraprakash Pramanik, Shovan Kumar Das, Tanmoy W Momin, Milan Chakraborty, Somenath Dasgupta, Agnibha Dutta

[1]ESIPGIMSR,Maniktola,Kolkata

Burdwan medical College,India.

Abstract

To find out the relationship between endothelial dysfunction and diabetes mellitus using flow mediated dilatation (FMD) of brachial artery as a surrogate marker.FMD of brachial artery was measured in 100 diabetic patients and compared with 50 age and sex matched healthy controls. The study was done at Burdwan Medical College and Hospital, a tertiary care teaching hospital situated in the eastern part of rural India in the state of West Bengal. This teaching institute has the catchment area of about 5 districts including parts of Bihar and Jharkhand states. Data analysis was done with simple linear regression analysis by SPSS 20th version for Windows.FMD of brachial artery was statistically significantly lower (p value < 0.05) in diabetic patients (5.19 ± 1.04) as compared to the control group (10.59 ± 0.97). ? The mean FMD of brachial artery is 5.90±0.58 and 4.13±0.59 in non-smoker and smoker respectively, 6.16±0.50 and 4.49±0.73 in non-hypertensive and hypertensive respectively, 6.16±0.50 and 4.49±0.73 in non-dyslipidaemic and dyslipidaemic respectively and all are statistically significant (p value <0.05). The mean FMD of brachial artery is 6.45±0.38; 5.18±0.48 and 3.72±0.44 in patients having BMI of <25, 25-30 and>30 respectively.Thus it is clearly evident that FMD is also impaired by other factors like BMI of the patients, smoking, hypertension, dyslipidaemia in addition to diabetes mellitus. Diabetic patients had increased endothelial dysfunction as evident. It is also evident that other co-morbidities like smoking, increased BMI, hypertension, dyslipidemia are also causes endothelial dysfunction as evident by Flow Mediated Dilatation of Brachial Artery.

Key Words: Endothelial dysfunction, Flow mediated dilatation of brachial artery, diabetes mellitus, age, sex.

INTRODUCTION

Diabetes mellitus is a common metabolic disease worldwide affecting approximately 366 million people in 2011, which is predicted to rise to 552 million in 2030.[1] Cardiovascular disease causes most of the excess morbidity and mortality in diabetes mellitus. Adults with diabetes are at a 2 to 4-fold increased risk of cardiovascular events relative to those without diabetes.[2]

Dysfunction of the vascular endothelium is regarded as an important factor in the pathogenesis of micro- and macro-angiopathy. FMD is the most widely used non-invasive test which gives a reliable and valid estimate of early disease of arterial wall. This study will assess the endothelial dysfunction in diabetes mellitus by measuring FMD of brachial artery and explore the relation of endothelial dysfunction with other risk factors like hypertension, smoking, dyslipidaemia etc.

Some studies.[3,4,5] showed that diabetic patients had lower value of FMD of brachial artery as compared to non-diabetics while 0ther study [6] showed that diabetes itself did not carry a higher risk of endothelial dysfunction as compared to normal.

MATERIALS AND METHODS

The study was an institution based cross-sectional observational study which had been conducted in Burdwan Medical College and hospital, Burdwan , West Bengal, India with 100 diabetic patients and 50 age and sex matched healthy controls who were non-diabetic, non-hypertensive, non-smoker, non-dyslipidaemic etc. A case of Diabetes mellitus should meet the following criterias of FBG ≥126 mg/dl Or, 2 hours plasma glucose ≥ 200 mg/dl Or, symptoms of diabetes (polyuria, polyphagia, polydipsia) with RBG ≥200 mg/dl.

Patients with diabetic nephropathy, chronic renal failure, cerebro-vascular accidents, acute myocardial infarction, ischaemic heart disease, chronic liver diseases etc which could affect the outcome of the study had been excluded.

A thorough careful history including age, sex, duration of diabetes, H/O smoking, hypertension etc and height, weight and blood pressure of the patients were noted.Patients who used cholesterol lowering medication or had a total serum cholesterol level ≥200 mg/dl were classified as having hypercholesterolemia or dyslipidaemia.[7]

Measurement of FMD of brachial artery by Doppler study:

Examination of the brachial artery was performed with a 7 MHz linear probe with a duplex ultrasound system with 7.5MHz scanning frequency in the B-mode, pulsed Doppler mode and colour mode. All examinations and measurements were performed by same examiner to exclude examiner bias. Baseline diameter of brachial artery was measured by ultrasound system and then the BP cuff was inflated to suprasystolic pressure (>50 mm of Hg above systolic pressure) for 5 minutes. Then the cuff was deflated and diameter of brachial artery was measured at 15 seconds and 1minute of cuff release and the average of the two measurements was noted. FMD of brachial artery was calculated by following formula:

FMD % = (average of brachial artery diameter measured at 15 seconds and 1minute of cuff release – initial baseline diameter of brachial artery) / initial baseline diameter.

RESULTS

Diebetic patients include 65 males and 35 females while the control group include 32 males and 18 females. All the females are non-smoker. Out of 65 diabetic males 40 (61.53%) are smoker.

Address for correspondence*

Pijush Kanti Mandal,

Vill-Haripur,P.O.-Ekorna, Dist-Malda,West Bengal, India.Email-pkmbmoh@gmail.com

Table : 1 Co-relation of FMD with various risk factors in diabetics

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
Age	-0.056	0.023	-0.528	-2.500	0.014
BMI	-0.214	0.079	-0.568	-2.722	0.008
Smoking	-0.679	0.116	-0.319	-5.852	0.000
hypertension	-0.157	0.077	-0.074	-2.029	0.045
dyslipidaemia	-0.195	0.069	-0.093	-2.833	0.006
duration of diabetes	-0.845	0.090	-0.591	-9.425	0.000
fasting plasma glucose	-0.009	0.003	-0.178	-2.681	0.009
postprandial plasma glucose	-0.023	0.002	-0.777	-14.208	0.000
glycated haemoglobin	-0.640	0.291	-0.392	-2.201	0.030

Table: 2 Comparison between the two groups of patients : diabetic and non-diabetic

VARIABLES	DIABETIC	NON-DIABETIC	P value
Mean age in years	52.28±9.84	53.28±9.40	<0.05
Mean BMI	27.51±2.77	25.68±2.33	<0.05
Mean FPG (mg/dl)	173.86±19.90	85.76±9.29	<0.05
Mean PPPG (mg/dl)	258.15±35.77	24.44±8.81	<0.05
Mean HbA1C (%)	7.68±0.64	5.58±0.61	<0.05
Mean FMD (%)	5.19±1.04	10.59±0.97	<0.05

All the healthy controls are non-hypertensive & non dyslipidaemic, non-smoker. Out of 100 diabetic patients 58 are hypertensive and 53 are dyslipidaemic. The mean FMD of brachial artery is 10.59±0.97 in non-diabetic group and 5.19±1.04 in diabetic group. By the independent T test it is evident that there is significant difference in FMD of brachial artery (p<0.05) among the two groups. The results are shown in the table

The simple regression analysis shows significant negative correlation of FMD in diabetic patients with age, BMI, smoking, hypertension, dyslipidaemia, duration of diabetes, fasting and postprandial plasma glucose, glycated haemoglobin.

The mean FMD of brachial artery is 5.90±0.58 and 4.13±0.59 in non-smoker and smoker respectively, 6.16±0.50 and 4.49±0.73 in non-hypertensive and hypertensive respectively, 6.16±0.50 and 4.49±0.73 in non-dyslipidaemic and dyslipidaemic respectively and all are statistically significant (p value <0.05).

The mean FMD of brachial artery is 6.45±0.38; 5.18±0.48 and 3.72±0.44 in patients having BMI of <25, 25-30 and>30 respectively.

From the ANOVA & Tukey HSD as posthoc test for multiple comparison it is evident that there is significant difference in FMD of brachial artery (p<0.05) among the three groups depending upon the BMI group of the patients.

DISCUSSION

In this study, it is found that FMD of brachial artery in patients with diabetes mellitus is 5.19 ± 1.04 and in healthy control group is 10.59 ± 0.97 and this difference is statistically significant (p< 0.05). This result is similar with other studies [3,4,5,8].

FPG, PPG, HbA1C has significant negative correlation with FMD of brachial artery (p value <0.05). Studies[8,9] showed that FMD had negative correlation with FPG and PPPG (p value 0.028). Eliana F et al [9] observed that FMD of brachial artery had inverse correlation with PPG and HbA1C (p value < 0.05).

FMD of brachial artery is significantly inversely correlated with BMI of the patients (p<0.05). Emelia J. Benjamin et al [10] observed that FMD has negative correlation with BMI of the patients while Schroeder et al [11] observed that FMD has no relation with BMI of the patients.

Smoking has a significant association with FMD of brachial artery (p <0.05). Smokers have a FMD of 4.13 ± 0.59 as compared to 5.90 ± 0.58 in non-smokers. Celermajer DS et al [12] & MP Holay et al [13] showed that FMD was lower in smokers compared to normal group.

Hypertension has a significant correlation with FMD of brachial artery (p< 0.05). Hypertensives have a FMD of 4.49 ± 0.73 as compared to 6.16 ± 0.50 in non-hypertensives. In a study it was observed that FMD has negative correlation with systolic blood pressure of the patients[10]. Corina Serban et al [14]

showed that hypertensives had a lower value of FMD as compared to non-hypertensives.

Dyslipidaemia has a significant negative correlation with FMD of brachial artery ($p< 0.05$). Dyslipidaemic patients have a FMD of 4.42 ± 0.73 as compared to 6.06 ± 0.55 in non-dyslipidaemic patients.Some studies showed that blood level of cholesterol had a negative correlation with FMD of brachial artery [15]. Significant negative correlation with TG, LDL and HDL level has also been observed in some studies [16].

CONCLUSION

ØThis study shows diabetic patients have a lower value of FMD of brachial artery and hence suggesting increased endothelial dysfunction as compared to non-diabetics.ØFMD is also impaired by other factors like BMI of the patients, smoking, hypertension, dyslipidaemia etc.ØSo if we can control these factors along with control of blood glucose; we may be able to minimize the endothelial dysfunction.

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