COMPARISON OF LEFT CORONARY ARTERY DIAMETER AMONG DIABETICS AND NON-DIABETICS

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ABSTRACT

Objective: *To compare the left coronary artery diameter between diabetic and non-diabetic patients undergoing coronary angiography.*

Methodology: *This was a hospital based cross sectional comparative study. After obtaining an informed consent, 139 patients each in diabetic and non-diabetic groups were selected by non-probability purposive sampling method. Coronary angiography was done through femoral approach using Seldeinger technique and standard views were taken. Quantitative analysis of digital angiograms was performed. Data analyzed using SPSS version 11.0. Independent t test was applied to calculate mean coronary artery size between diabetic and non-diabetic patients. A p-value of less than 0.05 was considered significant.*

Results: *Out of 278 patients included in the study, 139 (50%) were diabetics and 139 (50%) were non-diabetics. Males were 168 (60.4%) as compared to females 110(39.6%). Mean age was 52.82 ± 7.115, and mean body surface area was 1.8004 ±.11094. There was significant difference in coronary diameters of LAD (p value 0.000), LMS (p value 0.008), and distal Cx coronary arteries (p value 0.000) between the two groups.*

Conclusion: *In this study, left coronary arteries and its branches were found to be narrower in diabetic patients than in non-diabetics.*

Key Words: *Diabetes mellitus, Coronary Arteries, Quantitative Coronary Angiography.*

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INTRODUCTION

Diabetes mellitus has reached epidemic proportions and continues to increase. Its prevalence is rapidly increasing in both developing and developed countries[1]. Worldwide the prevalence of diabetes in all age groups was estimated to rise from 2.8% in 2000 to a projected 4.4% in 2030. The total number will accordingly increase from 171 million to 366 million diabetic patients in 2030[2].

Pakistan with diabetes prevalence of 5.2 millions in year 2000 is on number 6 in the top 10 countries of the world with highest diabetes prevalence. This figure is estimated to rise to 13.9 millions of diabetes prevalence in Pakistan in year 2030 and accordingly Pakistan will occupy the 5th position in the list in year 2030[2].

Cardiovascular disease is increased in individuals with type 1 or type 2 DM. It is the major cause of morbidity and mortality with up to 75% of all such individuals succumbing to some form of cardiovascular disease (CVD)[3,4]. Twenty per cent of people with diabetes have evidence of cardiovascular disease at the time diabetes is diagnosed[5].

Coronary artery disease is more likely to involve multiple vessels in individuals with DM. Those with no history of vascular disease are at increased risk of suffering a first vascular event earlier than those without diabetes[5].

The left coronary artery emerges from the aorta through the ostia of the left aortic cusp within the sinus of Valsalva. The left coronary artery (LCA) travels from the aorta, passes between the right ventricle outflow tract anteriorly

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and the left atrium posteriorly. It then divides into left anterior descending artery (LAD) and circumflex artery (Cx) and is thus a very short vessel[6,7].

Coronary arteries in diabetic patients appear to be narrower than in normal subjects[8]. Smaller coronary arteries in south Asians as compared to Caucasian contribute to a poor outcome in Asian population. The diameter of coronary arteries in Pakistani population is not significantly different to that of Caucasians[9,10]. Women have smaller coronary artery size which may account for worse outcome after myocardial infarction and coronary revascularization[11].

The smaller dimension of some coronary artery segments has important diagnostic and therapeutic implications since for any interventional procedure the absolute size of coronary artery matters[12].

So far only few studies have been conducted on coronary artery size in non-diabetic subjects. Only one study[8] has compared the coronary arteries sizes between diabetic and non-diabetic patients internationally and no local study has examined this subject.

The aim of this study was to compare the left coronary artery dimensions between diabetic and non-diabetic patients. The rationale of this study was that it will help clinicians to know the left coronary artery size in diabetic and non-diabetic patients and guide their decision-making in interventional procedures. This study was thus planned to compare the left coronary arteries diameter in diabetic and non-diabetic patients undergoing coronary angiography.

METHODOLOGY

This was a hospital based cross sectional comparative study. The study was carried out in catheterization laboratory cardiology unit Lady Reading Hospital, Peshawar. Hospital ethical committee had approved this study. After obtaining an informed consent, 139 patients each in diabetic and non-diabetic groups were selected by non-probability purposive sampling method.

Diabetes was diagnosed when patient has taken oral anti hypoglycemic drugs, insulin or FBS $\geq$126mg/dl on two consecutive occasions. Patients who were known diabetic or were taking oral hypoglycemic or insulin therapy were enrolled in diabetic group. In non diabetic group patients had no previous history of diabetes mellitus. FBS was performed only in doubtful cases if found high more than 126mg/dl on two occasions were labeled diabetic and were included in diabetic group.FBS was not performed in all cases.

The segments of the left coronary artery were:

Left main stem (LMS):

From origin of left coronary sinus to before bifurcation of left coronary artery.

Proximal LAD (L1):

Before origin of first septal branch from left anterior descending coronary artery.

Mid LAD (L2):

Between origin of first septal and first diagonal branch.

Distal LAD (L3):

After the first diagonal branch.

Proximal circumflex (Cx1):

Before origin of first obtuse marginal (OM1) branch from circumflex artery.

Distal circumflex (Cx2):

After the origin of (OM1) from circumflex artery.

All the diabetic and non diabetic patients of all age groups who undergo coronary angiography for any indication were included in the study. Patients with diseased coronary artery segment (it could underestimate the coronary vessel diameter); Radio Contrast allergy (dangerous for patient); Ectatic vessels (it might overestimate the real diameter of coronary artery); End stage renal failure (in these patients coronary vessels were calcified and having advanced atherosclerosis) and Coronary anomalies (vessels may be narrower or ecstatic) were excluded from the study.

Patients fulfilling the inclusion criteria were enrolled in the study. FBS was not performed in all cases but only in doubtful cases in whom history of diabetes was not clear. The purpose of doing FBS was to group them in either diabetic or non diabetic population. Comparison of blood sugar level was not the aim of our study. Lipid levels were obtained from hospital laboratory. Weight and height were measured using height and weight machine (RGZ-160) to calculate body surface area using formula. Mosteller[13] formula. Body surface area was well matched between the two study group to rule out the possible bias as body surface area may have effect on coronary artery diameter.

$$\sqrt{\frac{\text{Height (cm)} \times \text{weight (kg)}}{3600}}$$

After this coronary angiography was done through femoral approach using Seldeinger technique and standard views were taken. Quantitative analysis of digital angiograms was performed using machine Siemens Axiome Artis with Syngo Software Version VB 22 N. It consists of digitalization, calibration and contour detection. Calibration was performed by catheters as a scaling device. Confounding variable were controlled by matching characteristic of the two groups such as age, gender, risk factor like hypertension, dyslipidemia and family history. Bias was controlled by using same angiography machine and software and the reporter was kept blind to the study group. All information was recorded on a standard proforma.

Data were analyzed using SPSS version 11.0. Mean ± standard deviation (SD) was calculated for numerical variables like age, body surface area, FBS, lipid levels and sizes of left coronary artery segments. Discrete variables such as gender, diabetes mellitus and hypertension were presented in frequency and percentages. Independent t test was applied to calculate mean left coronary artery size between diabetic and non-diabetic patients. P Value was generated and less than 0.05 was considered significant. Data were presented in different tables.

RESULTS

Out of 278 patients included in the study, 139 (50%) were diabetics and 139 (50%) were non-diabetics. Male patients were 168 (60.4%) and female patients were 110(39.6%), with an overall male to female ratio of 1.52: 1. Lipid profile and body surface area are given in tables below.

Mean age of the study patients was 52.82±7.115, mean weight was 69.7536±4.63871, mean height was 167.8417±3.86180 and mean body surface area was 1.8004±.11094. Mean serum triglyceride levels were 161.29±59.505 and mean serum LDL-cholesterol levels were 90.36±27.177. Hypertension was found in 125 (45%) of patients and.

Baseline Characteristics of diabetic and non-diabetic patients are shown in Table 1 and 2.

After exclusion of non-evaluable and diseased coronary artery segments, the diameters of the normal left coronary arteries and their branches were measured and compared in both

Table 1: Baseline Characteristics of diabetic (n=139) and non-diabetic patients (n=139)

	Diabetes	Mean	Std. Deviation	Std. Error of Mean	P value (significant <0.05)
Age (in years)	Yes	52.77	7. 531	.639	0.913
	No	52.86	6.786	.576	
Body surface area (in ms)	Yes	1.8071	.07911	.00671	0.313
	No	1.7937	0.13548	.01149	
LDL level (mg/dl)	Yes	95.53	25.036	2.12	0.001
	No	85.19	28.318	2.402	
Triglycerides (mg/dl)	Yes	168.49	58.138	4.931	0.043
	No	154.09	60.189	5.1054	

Table 2: Comparison of Hypertension between two groups

Diabetes Mellitus	Hypertension		Total	P Value (significant <0.05)
	Yes	No		
Yes	66 (47.5%)	73 (52.5%)	139	0.399
No	59 (42.4%)	80 (57.6%)	139	
Total	125 (45%)	153 (55%)	278	

Table 3: Comparison of left Coronary Artery Dimensions among diabetics & non diabetics

	Diabetes	Mean	Std. Deviation	Std. Error of Mean	P value (significant <0.05)
Left Main Stem	Yes (n=138)	4.0754	.29611	.02521	0.008
	No (n=138)	4.1843	.37560	.03197	
Proximal LAD L1	Yes (n=75)	2.9920	.16002	.01848	0.000
	No (n=101)	3.1024	.20155	.01894	
Mid LAD L2	Yes (n=96)	2.9501	.16806	.01715	0.000
	No (n=113)	3.1447	.18827	.01771	
Distal LAD L3	Yes (n=111)	1.9591	.45196	.04290	0.000
	No (n=126)	2.4217	.39303	.03501	

Table 4: Comparison of Circumflex Coronary Artery Dimensions among diabetics and non-diabetics

	Diabetes	Mean	Std. Deviation	Std. Error of Mean	P value (significant <0.05)
Proximal LCX C1	Yes (n=111)	2.9974	.19122	.01815	.379
	No (n=125)	3.0210	.21623	.01934	
Distal LCX C3	Yes (n=118)	1.8594	.43236	.03980	0.000
	No (n=133)	2.2978	.42675	.03700	

groups.

Left main stem coronary artery (LMS) and segments of left anterior descending (LAD) coronary artery sizes in diabetics and non-diabetics are shown in Table 3.

Sizes of various segments of left Circumflex (LCx) coronary artery in diabetics and non-diabetics are shown in Table 4.

DISCUSSION

Diabetes increases the risk of developing coronary artery disease by 2- to 4-fold[14,15].

Their disease severity, compared with non-diabetics is worse in the form of more extensive, diffuse, and distal coronary artery disease[15,16].

Patients with diabetes mellitus account for approximately one-quarter of all patients who undergo coronary revascularization procedures each year and they experience worse outcomes compared with non-diabetic patients[17].

Several studies[18,19] have shown that the increased cardiovascular risk associated with diabetes may not only be due to conventional risk factors, but that intrinsic factors related to diabetes or pre-diabetes are likely to be important.

In the present study 139 patients in each of diabetic and non-diabetic groups were studied. Both groups were comparable and matched for age, sex, body surface area, serum lipids and hypertension. These are baseline characteristics which are well matched to nullify any possible bias. The comparison is only the coronary artery diameter between diabetic and non diabetic population.

In general, males had larger coronary artery dimensions as compared to females even after correcting for body surface area[9,20]. They had a statistically significant larger diameter of the left main coronary artery (LMCA), the distal circumflex (CX), the diagonal (DG) and the posterior left ventricular branch (PLV) ($p<0.05$).

The difference however was not found to be significant in the proximal CX, all the three segments of the left anterior descending (LAD), the right coronary artery (RCA) and the posterior descending artery (PDA)[12]. In another study gender was not found to be a confounding factor since the control group had a larger proportion of women and still larger arteries than the diabetic group[8].

Mean age of our patients was similar to other studies showing 49.23±9.43 years[12] and 53.3±10.3 years in Caucasians and 50.9±11.7 in Asians[21]. In the study by Dodge JT et al, lumen diameter was not affected by age or by vessel tortuosity[20].

Plasma concentrations of intermediate-density lipoprotein are a positive predictor of disease severity, whereas high-density lipoprotein concentrations are a negative predictor in patients with type 2 diabetes[22]. While total cholesterol and LDL levels may be similar to other ethnic groups, South Asians have characteristic lipid profiles increasing their risk for coronary artery disease (CAD). These are: higher triglyceride levels, higher lipoprotein (a) levels, increased ratio of apolipoprotein B to apolipoprotein A-1 (apoB/apoA-1), smaller HDL and LDL particle size, and lower levels of HDL[23-25].

In our study there was significant difference in LDL and TG levels between diabetics and non diabetics population.But one limitation of this study was that it did not look into other lipid markers like apo A-1, apoB, smaller HDL and LDL particle size[23-25].

Mean body surface area of our patients was 1.8004±0.11094 m^2, which is similar to the study by Lip GY showing 1.88±0.19m^2 in Caucasians[21]. Although in an Indian study the mean body surface area of 1.68 ± 0.17m^2 was lower than our study.[12] when we compared mean body surface area in both groups of diabetics and non-diabetics there was no statistical significant difference (p value 0.313).

The present study aimed to investigate angiographic profiles of the coronary arteries in diabetic patients in comparison with non-diabetics. In our study there was significant difference in coronary diameters of LCA (*p* value 0.000), in both groups.

Coronary arteries in diabetic patients appear to be narrower than in normal subjects. Specific arteries and their branches that were significantly smaller in diabetics included: left main coronary artery, distal LAD[8].

In a Chinese study diabetics presented with angiographically documented more severe and diffuse coronary artery disease compared to non-diabetics[26].

Smaller mean coronary artery diameter has also been proposed as a risk factor for CAD in South Asians. A 2005 study done at Long Island Jewish Medical Center compared coronary artery diameters of 274 Whites to 149 South Asians referred for chest pain, cardiomyopathy, or valvular heart disease[27,28]. Only normal coronary angiograms were included in the study. South Asians had significantly smaller coronary artery diameters, even when corrected for body surface area.

Two other studies by Lip GY et al and Dhawan J et al, had shown smaller coronary artery diameters in South Asians, but the trend was not significant when corrected for body surface area[21,29], leading them to the conclude that the smaller size of the coronaries in Indian Asians is attributable to their relatively smaller body surface area. However smaller coronary arteries would theoretically require a lower atheroma burden to develop critical stenosis, possibly leading to premature CAD. Also the study by Dhawan and Bray[29]only measured the proximal segments of disease free coronary arteries in a consecutive series of 72 male Caucasian and 70 male Indo-Asian patients undergoing cardiac catheterization; they derived a total coronary artery diameter (tCAD) by adding the diameters of proximal right, left anterior descending and circumflex arteries.

Several studies around the world have consistently revealed an increased likelihood of CAD at an earlier age with more extensive disease in people of South Asian origin[30,31]. More severe CAD and high mortality in the people of South Asian origin may be due to smaller diameter of their coronary arteries[21,26,32].

In a study of South Asian and Caucasian men it was found that with comparable demographic and clinical characteristics they have angiographically similar proximal coronary artery size and severity of CAD. This finding refutes any suggestion that South Asian patients have smaller coronary arteries per se[9].

Similar results were shown by a local study and stated that the diameter of coronary arteries of Pakistani population is not significantly different from that of Caucasians and that the increase morbidity and mortality in the people of South Asian origin may be due to some other factor(s)[10].

The dimensions of the coronary arteries are highly variable in the normal population[33]. Genetic factors, age, sex, body weight, body surface area, weight of the heart and ethnic / racial factors have all been correlated with the coronary artery anatomy in various studies[29,33].

The smaller dimension of some coronary artery segments has important diagnostic and therapeutic implications since for any interventional procedure the absolute size of the coronary arteries matters. It has been reported that occlusion or thrombosis is more common in vessels less than 2.5 mm in diameter[21].

Coronary artery size has impact on treatment options and outcome such as attachment of grafts during Coronary Artery bypass Graft, CABG, (smaller arteries causing anastomotic technical difficulties and poor run-off) as well as difficulties during balloon angioplasty and stenting. Smaller body surface area (and thereby smaller coronary artery size) was associated with increased risk of in-hospital death from heart failure after CABG[34]. Furthermore, small target vessel size is associated with an increased risk of re-stenosis and repeat revascularization[35,36].

CONCLUSION

In this study, left coronary arteries in diabetic patients were found to be narrower than in non-diabetics.

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CONTRIBUTORS

F conceived the idea and planned the study. MA, MN & HJ did the data collection and analyzed the study. MH supervised the study. All the authors contributed significantly to the research that resulted in the submitted manuscript.