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COMPARISON OF CORONARY ARTERY DIAMETER AMONG PATIENTS WITH AND WITHOUT DIABETES MELLITUS

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Contribution
All the authors contributed significantly to the research that resulted in the submitted manuscript.

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ABSTRACT

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

Methodology: This cross sectional comparative study was carried out in cardiac catheterization laboratory, from January to June 2010. Patients were divided into two groups; diabetics and nondiabetics. Coronary angiography was performed and quantitative analysis of coronary segments was performed.

Results: A total of 278 patients, 139 in each group were included in the study. Mean age±SD (years) in diabetic and nondiabetic groups was 52.8±7.531 V 52.9±6.79; P=0.91 respectively. Hypertension among diabetics and non diabetics were66(47%)V 59(42.4%) P=0.39 respectively. Left main stem coronary artery (LMS) in diabetics and non diabetics were 4 V 4.18 P=0.008 respectively. Proximal segments of left anterior descending (LAD) coronary artery sizes in diabetics and non-diabetics were 2.99 V 3.1P =0.000 while mid and distal segments were 2.95 V 3.14 P=0.000 and 1.95 V 2.42 P=0.000 respectively. Sizes of various segments of proximal left Circumflex (LCx) coronary artery in diabetics and non-diabetics were 2.99 V 3.0 P=0.37 while distal circ 1.85 V 2.29 P=0.000 respectively. Proximal segments of right coronary artery in diabetic and nondiabetic group were 3.02±0.25mmV 3.18±0.25mm; P=0.000 while mid and distal segments were 2.99±0.26V 3.18±0.25; P=0.000 and 2.43±0.51V2.87±0.32; P=0.000 respectively.

Conclusion: In this study, coronary arteries in diabetic patients were found to be narrower than in Non diabetic subjects. The right coronary artery , left main stem, left anterior descending and distal circumflex arteries were more significantly affected in diabetics and proximal circumflex was not significantly affected.

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

INTRODUCTION

Diabetes mellitus is a worldwide epidemic. Its prevalence is rapidly increasing in both developing and developed countries.[1] In Pakistan with an estimated prevalence of 12%, 6.9 million people are affected by diabetes and predicted to increase to 11.5 million by 2025. World Health Organization (WHO) has ranked Pakistan 6th on diabetes prevalence list.[2]

Coronary heart disease is highly prevalent and is the major cause of morbidity and mortality in diabetic patients$_1$. Diabetic patients have two to four folds increase in the risk of coronary heart disease and death than non-diabetic patients.[3]

Coronary arteries in diabetic patients appear to be narrower than in normal subjects.[4] Smaller coronary arteries in south Asians as compared to Caucasian contribute to a poor outcome in Asian population.[5] Women have smaller coronary artery size which may account for worse outcome after myocardial infarction and coronary revascularization.[6]

Smaller coronary artery size really matter and cause ischemia in right ventricle.[7] 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.[8] The diameter of coronary arteries in Pakistani population is not significantly different to that of Caucasians.[9]

So far only few studies have been conducted on coronary artery size in non-diabetic subjects. Only one study [4] 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 is to compare the coronary artery sizes between diabetic and non-diabetic patients. The rationale of this study is that it will help clinicians to know the coronary artery size in diabetic and non-diabetic patients and guide their decision-making in interventional procedures.

METHODOLOGY

This was a hospital based cross sectional comparative study which was carried out in cardiac catheterization laboratory of the department of cardiology from January 15 to June 15 2010 for total period of 6months. Hospital ethical committee had approved study protocol. Diabetes was diagnosed when patient was taking oral anti hypoglycemic drugs, insulin or FBS >126mg/dl on two consecutive occasions.

Using G.W. Snedecor & W.G. Cochran calculator for sample size calculation, above mentioned group means, standard deviations, 0.05 significance level and 80% power, sample size for each group was estimated to be 106 patients. However a larger sample of 139 patients was studied. After obtaining an informed consent, patients were recruited by non-probability purposive sampling method. Patients of any age and both gender who were undergoing coronary angiography for any indication were included in this study. Patients having following characteristics were excluded from study. Diseased coronary artery segment because it could underestimate the coronary vessel diameter. Radio contrast allergy which is dangerous for patient. Ectatic vessels which might overestimate the real diameter of coronary artery. End stage renal failure because in these patients coronary vessels are calcified and having advanced atherosclerosis. Coronary anomalies as vessels may be narrower or ecstatic. Coronary spasm and previous history of myocardial infarction with recanalization of the artery.

The segments of the coronary arteries for the left coronary artery were defined as:

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.

For the right coronary artery

Proximal RCA (R1): From right coronary sinus to before the origin of first acute marginal (AM1) branch.

Mid right coronary artery (R2): Between first and second acute marginal branch.

Distal RCA (R3): After the second acute marginal branch (Am2).

Patients fulfilling the inclusion criteria were enrolled in the study. Their fasting blood sugar and lipid levels were obtained from hospital laboratory. Weight and height was measured using height and weight machine (RGZ-160) to calculate body surface area using formula.

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

Coronary angiography was performed through standard Judkins technique and all standard views (RAO cranial and caudal, LAO cranial and caudal) were taken. Quantitative analysis of digital angiograms was performed by an

interventional cardiologist using SIEMENS AXIOME ARTIS with Syngo Software Version VB 22 N. It consists of digitalization, calibration and contour detection. The (known) catheter tip diameter was used as the calibration object to assess the size of artery, with the settings of the image intensifier constant. Measurements were uniformly taken in diastole. Each artery was measured in defined segments and measurements were taken of the widest dimension in each segment. Proximal, mid and distal segments were measured using 60° left anterior oblique projection.

Confounding variable were controlled by matching baseline characteristic between two groups such as age, gender, risk factor like hypertension, dyslipidemia and family history for CAD. Bias in the study 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 Statistical Package for Social sciences (SPSS) version 11.0. Mean + standard deviation (SD) was calculated for numerical variables while categorical variables were presented as frequencies and percentages. Comparison between two groups was performed by using student-t test for numerical variables and Chi-Square test for categorical variables. P Value 0.05 was considered significant. Results were presented in Tables.

RESULTS

A total of 278 patients, 139 in each group were included in the study. Male patients in diabetic and nondiabetic group were 86(61%) V 82(59%); P=0.64 respectively. Mean

Table 1: Baseline Characteristics of diabetic and non-diabetic patients

Characteristics	Diabetic Group (n=139)	Non-diabetic Group(n=139)	p-value
Age±SD (in years)	52.8±7. 531	52.9±6.79	0.91
Male/female	86/53	82/57	0.62
Hypertension	66(47.5%)	59(42.4%)	0.39
Body surface area (m^2)	1.80±.08	1.79±0.14	0.31
LDL level (mg/dl)	85.19±28.3	95.53±25.03	0.001
Triglycerides (mg/dl)	154.09±60.19	168.49±58.14	0.04

Table 2: Comparison of left coronary artery dimensions among diabetics and non-diabetics

	Diabetes	Mean	Std. Deviation	Std. Error 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 3: Comparison of circumflex coronary artery dimensions among diabetics and non-diabetics

	Diabetes	Mean	Std. Deviation	Std. Error 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	

Table 4: Comparison of right coronary artery dimensions among diabetics and non-diabetics

Segments of RCA	Measurement possible(n) in diabetic group	Diabetic Group	Measurement possible(n) in non-diabetic group	Non-diabetic Group	P-value
Proximal (R1)mm±SD	103	3.02±0.25	129	3.18±0.25	0.000
Mid (R2)mm±SD	100	2.99±0.26	123	3.18±0.25	0.000
Distal(R3) mm±SD	106	2.43±0.51	133	2.87±0.32	0.000

age±SD (years) in diabetic and nondiabetic groups was 52.8±7.531 V 52.9±6.79; P=0.91 respectively. Hypertension among diabetics and non diabetics were 66(47%)V 59(42.4%) P=0.39 respectively. Mean body surface area (M2) in diabetic and nondiabetic groups was1.80±.08 V 1.79±0.14; P=0.31 respectively. Mean serum triglyceride levels (mg/dl) in diabetic and nondiabetic groups were 154.09±60.19 V 168.49±58.14; P=0.04 respectively while mean serum LDL levels (mg/dl) were 85.19±28.3 V 95.53±25.03; P=0.04 respectively. These baseline characteristics are shown in Table 1.

Left main stem coronary artery (LMS) in diabetics and non diabetics were 4 V 4.18 P=0.008 respectively. Proximal segments of left anterior descending (LAD) coronary artery sizes in diabetics and non-diabetics were 2.99 V 3.1P =0.000 while mid and distal segments were 2.95 V 3.14 P=0.000 and 1.95 V 2.42 P=0.000 respectively (Table 2).

Sizes of various segments of proximal left Circumflex (LCx) coronary artery in diabetics and non-diabetics were 2.99 V 3.0 P=0.37 while distal circ 1.85 V 2.29 P=0.000 respectively (Table 3).

Proximal segments of right coronary artery in diabetic and nondiabetic group were 3.02±0.25mmV 3.18±0.25mm; P=0.000 while mid and distal segments were 2.99±0.26V 3.18±0.25; P=0.000 and 2.43±0.51V2.87±0.32; P=0.000 respectively. These results are summarized in Table 4.

DISCUSSION

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.[10,11] Several studies[12,13] 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. This hypothesis has been supported by studies showing that hyperglycaemia is positively associated with CVD, even after adjustment for potentially confounding factors.[14,15]

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. In general, males had larger coronary artery dimensions as compared to females even after correcting for body surface area.[16-18] The difference however was not found to be significant in the the right coronary artery (RCA).[7] 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.[5]

Mean age of our patients was 52.82 ± 7.115 years, which is similar to other studies showing 49.23 ± 9.43 years [7] and 53.3 ± 10.3 years in Caucasians and 50.9 ±11.7 in Asians.[19]In the study by Dodge JT et al, lumen diameter was not affected by age or by vessel tortuosity.[18] 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 ± 0.19 m^2 in Caucasians.[19] Although in an Indian study the mean body surface area of 1.68 ± 0.17m^2 was lower than our study.[7] 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).

Mean Serum triglyceride levels were 161.29 ± 59.505 whereas mean serum LDL-cholesterol levels were 90.36±27.177. 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.[20]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.[21-23]

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 RCA (p value 0.000), LAD (p value 0.000), LMS (p value 0.008), and distal Cx coronary arteries (p value 0.000) in both groups. While proximal segments of Cx coronary arteries were statistically insignificant (p values 0.379) in both groups. Specific arteries and their branches that were significantly smaller in diabetics included: left main coronary artery, distal LAD, first diagonal, proximal RCA, distal RCA, right ventricular branch, and postero-lateral and posterior descending artery of RCA origin.[5]

The right coronary artery was affected more often in diabetics ($p<0.01$).[24] Another study stated that there are a group of patients with small diameter of RCA causing probable ischemia in RV and small caliber of RCA can really matter in these patients.[6]

In a Chinese study diabetics were presented with angiographically documented more severe and diffuse coronary artery disease compared to non-diabetics. The right coronary artery was significantly more frequently involved in the diabetics.[25]

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,[17,26] 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.

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.[16]

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).[27]

The dimensions of the coronary arteries are highly variable in the normal population.[28] 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.[26, 28]

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.[19] 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.[29] Furthermore, small target vessel size is associated with an increased risk of re-stenosis and repeat re-vascularization.[30,31]

CONCLUSION

In this study, coronary arteries in diabetic patients were found to be narrower than in normal subjects. The right coronary artery , left main stem, left anterior descending and distal circumflex arteries were more significantly affected in diabetics and proximal circumflex was not significantly affected.

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