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DIAMETER OF NORMAL CORONARY ARTERIES IN ADULT PAKISTANIS

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Contribution

IAI,QAS and SN did literature research, data collection and designed the study. SN, AM did data analysis and interpretation . IAI wrote the final draft of the manuscript. All authors contributed significantly in manuscript submission.

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ABSTRACT

Objective: To determine the diameters of normal coronary arteries in a group of adult Pakistanis and to compare the results with the data mentioned in literature.

Methodology: Cross-sectional study conducted at Department of Cardiology, Shaikh Zayed Hospital, Lahore from December 2015 to December 2016. Study population comprised of patients who had normal coronary angiograms. The arterial segments were divided according to 29-segment model. The selected segments were studied by quantitative coronary angiography (QCA) method.

Results: Mean age of participants was 55.46±10.8 years, mean BSA, 1.84±0.187 and mean BMI was 28.18±2.4 Kg/m^2. Indexed coronary diameters of males and females were not significantly different. Diameters of Proximal left anterior descending (PLAD) and Proximal Left Circumflex (PLCx) were larger and diameter of left main stem was smaller in the present study compared to local studies. Diameter of Mid right coronary (MRCA) was larger and diameters of left main, proximal right coronary (PRCA), mid left anterior descending (MLAD), distal left anterior descending (DLAD) and distal left circumflex (DLCx) were smaller in the present study compared to Caucasians. Diameters of PLAD, MLAD, DLAD and PLCx were larger and diameters of left main stem and MRCA were smaller in the present study than Caucasians of another study.

Conclusion: Coronary artery diameters may have some peculiarities as some segments of the left stem were documented as smaller and other larger as compared to Caucasians.

Key Words: Coronary artery diameters, Pakistanis, comparison, Caucasians

INTRODUCTION

Coronary Artery Disease (CAD) is a multifarious chronic inflammatory disease, resulting in remodeling and blockage of the coronary arteries.[1] CAD is one of the leading reasons of mortality and morbidity worldwide.[2] It was earlier considered to be a disease prevalent in developed countries only but now it is equally common or even more common in developing countries.[3] Over the period of last 30 years, two epidemiological drifts have been seen for CAD mortality worldwide. It has been observed that in the developed countries there was initially a rise in CAD mortality and then a fall; on the other hand in developing countries CAD mortality is mainly found to be on the rise. In fact, according to World Health Organization (WHO) estimation about 60% of global burden arising from CAD is present in developing countries.[4]

Several research studies conducted in different parts of the world have constantly reported an increased probability of CAD starting at an earlier age and with more severe disease in people belonging to South Asian region.[5-9] Mortality resulting from CAD is 40% higher in people of South Asian origin as compared to Caucasian population. South Asians are also at 4 times increased risk of developing Myocardial Infarction (MI), having more severe coronary artery disease seen angiographically.[10] According to Western data, South Asians have more severe disease than their Caucasian counterparts. Triple vessel disease and left main stem disease has been found to be more prevalent in South Asian population.[11]

The high incidence of coronary artery disease among South Asians cannot be elucidated by merely a high occurrence of hypertension, smoking, total cholesterol, or vasculo-toxic lipids.[12] Mortality rates subsequent to coronary artery bypass graft (CABG) are also higher and some authorities believe that this difference in mortality is due to smaller coronary arteries in Asians[13] but other studies show that difference in size is not significant.[14]

The smaller diameters of some segments of the coronary arteries hold significant diagnostic and therapeutic consequences as for carrying out any interventional procedure the accurate diameter of the coronary arteries should be known.[15] Literature has shown that blockage or thrombosis is more frequent in vessels having a diameter of less than 2.5 mm as compared to larger vessels.[16] A moderate level (60%) stenosis in a vessel with 2.5 mm diameter would have more severe unfavorable effects on blood flow compared to the same level of stenosis in a vessel having a diameter of 3.5 mm, as the cross sectional area of the former vessel is reduced. Thus a moderate level (60%) stenosis would result in-considerable blockage in a vessel with smaller diameter having important implications in revascularization of coronary arteries.[17]

In studies conducted there are extensive differences in the results, approach, equipment and experimental design and data remains sparse and contradictory.[16,18,19] Lip et al. took normal angiograms but did not use digital quantitative coronary angiography (QCA) method for measurements, Hasan et al. used QCA but indexed diameters, Dhawan and Bray took abnormal angiograms and studied the proximal disease free segments.[20,21] These studies showed that South Asians have smaller coronary artery diameters compared to Caucasians. However, Zindrou did not find a significant difference in coronary artery diameters of the two groups. Moreover, the data is mostly from non-South Asian centers. Some South Asian studies including work done by Saikrishna and Kaimkhani contradict that South Asians have smaller coronary arteries, but they also included diseased coronary arteries and measured the normal looking segments.[13,14,17]

Presently there is very little data available about normal coronary artery diameter of the Pakistani population. This study was conducted to ascertain data for normal dimensions of different segments of the coronary arteries of a cohort of adult Pakistanis, by selecting visually normal angiograms and by using quantitative coronary angiography. The diameter of coronary arteries was measured by QCA and compared with the results mentioned in the literature for Caucasians and other South Asians.

METHODOLOGY

It was a cross-sectional descriptive study conducted at Department of Cardiology, Shaikh Zayed Hospital, Lahore for a period of one year from December 2015 to December 2016. The sample size was estimated by using 95% confidence level and 90% power of test with expected mean diameter of distal Right coronary artery 1.69 mm with standard error of 0.15.[16] The estimated sample size was 110. Study population comprised of patients for whom angiography was recommended but had normal coronary angiograms (record of normal coronary angiograms was taken from the archives of Cardiac Catheterization Laboratory (Cath-Lab) of Shaikh Zayed Hospital Lahore).

Inclusion criteria for the current study were normal angiograms of patients of both genders having age $\geqslant$ 18 years. Exclusion criteria were non-Pakistanis, use of I/V vasodilators during angiography, dilated cardiomyopathy (DCMP) and Left ventricular hypertrophy (LVH). After approval of the study from technical review board and ethical review board (IRB number: 1309) of Shaikh Zayed Hospital, a formal permission was taken from the director of Cath-Lab for conducting the study. The coronary angiography films which were reported as normal were collected and analyzed. The identity of the patient, angiography film and medical record number were replaced by a patient identification number in the proforma and identity of each patient was kept confidential.

The data regarding baseline characteristics (and co-morbidities) including age, gender, weight, height, blood pressure, pulse rate, diabetes, hypertension, smoking, serum creatinine, LVH and DCMP was collected from medical notes for the respective angiography film and medical history file of each patient. Mosteller formula was used for calculation of body surface area (BSA). BSA was used for indexing of coronary artery diameters.

$$BSA\ (m^2) = \sqrt{\frac{Height\ (cm) \times Weight\ (kg)}{3600}}$$

Standard angiographic views, LAO 60^0 was taken to measure the diameter of RCA while RAO 30^0 view was taken to measure diameter of LAD and LCx. The rationale of taking these views was that in these projections, the vessels and the catheter run in a plane nearly parallel to the x-ray tube and there is no significant magnification of the vessels with comparison to the catheter.[16,18]

The arterial segments were divided according to 29-segment model, and the following segments were studied: Left main stem 11, proximal LAD 12, mid LAD 13, distal LAD 14, proximal RCA 1, mid RCA 2, distal RCA 3, proximal LCx18 and distal LCx 19. The selected segments of these vessels were studied by QCA method in end-diastolic frame. Measurements were made from the most proximal, uniformly distended with contrast, free of tortuosity or kinking and with no overlap with other coronary arteries.[23-24] The reason of adopting the method of QCA was that this enables the operator to assess the actual size of the vessel objectively. Several studies have validated the accuracy of digital quantitative estimation of coronary dimensions therefore this method was selected.[20,21, 25-26]

Using Infinix Toshiba Japan machine, the measurements were done on commercially available computer systems DPF-2000 Toshiba Corporation, Japan and proprietary software. Calibration was made in relation to contrast filled angiographic catheter itself, the diameter of the catheter used being already known, by automated edge detection technique and the vessel contours was detected by operator independent edge detection algorithms. The dimension of the coronary artery was measured which gave the absolute diameter in millimeters (mm) calculated by computerized software analysis.[27-28]

Statistical analysis was performed using IBM-SPSS Statistics 20 software. Descriptive statistics (e.g. weight, height, body surface area etc) was used to describe demographic data. Quantitative demographic and clinical characteristics between male and female participants were compared by using student's t-test whereas categorical variables were compared by Chi-square test. Coronary artery diameters of males and females were compared by using student's t-test for two independent samples by using SPSS software. Comparison of mean coronary artery diameter, (both indexed to the body surface area and without indexing), between the present study and the previous studies was done by t-test for two independent samples and assuming equal variances, by using an online software, Simple Interactive Statistical Analysis (SISA).P value of less than 0.05 was considered as statistically significant in all cases.

Normal coronary arteries: No visible disease or luminal irregularities angiographically. Dilated cardiomyopathy (DCMP): Ejection fraction of less than 40% in the presence of increased left ventricular dimension. Left ventricular hypertrophy (LVH): An increase in the mass of the left ventricle, which can be secondary to an increase in wall thickness, an increase in cavity size, or both.

Segment 1 proximal RCA: From the ostium of RCA to one half the distance to the acute margin of heart. Segment 2 mid RCA: From the end of first segment to the acute margin of heart. Segment 3 distal RCA: From the acute margin to the origin of posterior descending artery. Segment 11 left main stem: From the ostium of left coronary artery to bifurcation into LCX and LAD. Segment 12 proximal LAD: Proximal to and including first major septal. Segment 13 mid LAD: Distal to the origin of first major septal to the point where LAD forms an angle (RAO view). If this angle is not identifiable then this segment ends one half the distance from first septal to the apex of heart. Segment 14 distal LAD: Beginning at the end of previous segment to or beyond the apex. Segment 18 proximal LCX: Main stem of circumflex from its origin from left main and including first obtuse marginal branch. Segment 19 distal LCX: From the end of segment 18 to where LCX enters into posterior atrio-ventricular groove.[20]

RESULTS

Angiograms of a total of 110 patients were selected according to inclusion and exclusion criteria from archives of Cardiac Catheterization laboratory. Study participants had a mean age of 55.46±10.8, minimum age was 33 years and maximum was 80 years. Mean BSA of study participants was 1.84±0.187 and mean BMI was 28.18±2.4. Baseline characteristics of male and female patients were similar except BMI and BSA (Table 1). BMI of female patients was significantly higher (p=0.000) as compared to male patients however, BSA of female patients was lower (p=0.000) than male patients.

Coronary artery diameters of all participants with and without indexing with body surface area are presented in Table 2. Apparently, non-indexed coronary artery diameters were larger compared to indexed coronary artery diameters. Coronary artery diameters of male and female patients, after indexing are shown in Table 3. Diameter of all coronary arteries showed no statistically significant difference between males and females, after indexing.

Comparisons of non-indexed coronary artery diameters of present study with two other local studies, (Kaimkhani et al.

and Faridullah et al.) are detailed in Table-4. In comparison to Kaimkhani et al. study, diameters of PLAD, PLCx were larger and diameter of left main stem was smaller in the present study. On comparing coronary artery diameters of the present study with non-diabetic group of Faridullah et al. study it was found that the diameters of PLAD, PLCx were larger and diameters of left main stem, MLAD, DLAD and DLCx were smaller in the present study.

Comparison of indexed coronary artery diameters of the present study with South Asians and Caucasians of Lip et. al. study are presented in Table 5. Comparison with South Asian group of Lip et al. study, showed that indexed diameter of MRCA is larger and diameters of left main, PRCA, MLAD, DLAD and DLCx are smaller in the present study. Comparison with Caucasian group of Lip et al. study showed that diameters of PLAD and PLCx are not different whereas,

Table 1: Demographic and Clinical Characteristics of Male and Female Patients (n=110)

Characteristics	Male patients m±SD	Female patients m±SD	p-value
Age (years)	54.2±11.4	57.8±9.5	0.602
BMI (Kg/m^2)	27.3±1.6	30.3±2.8	0.000
BSA (m^2)	1.85±0.02	1.81±0.04	0.000
Serum Creatinine (mg/dl)	0.98±0.18	0.96±0.16	0.673
Systolic Blood Pressure(mmHg)	134.9±13.2	131.5±12.7	0.456
Diastolic Blood Pressure (mmHg)	81±10.3	82.8±8.1	0.405
Pulse/minute	79.2±7.04	77.6±5.8	0.344

Table 2: Coronary Artery Diameters of Study Participants with and Without Indexing (n=110)

Coronary artery	Coronary artery diameters (mean±sd) Without indexing	Indexed coronary artery diameters (mean±sd)
Left mainstem	4.087±0.345	2.09±0.211
P LAD	3.572±0.31	1.884±0.172
M LAD	2.751±0.36	1.451±0.193
D LAD	1.749±0.33	0.9242±0.183
PLCx	3.195±0.39	1.687±0.227
D LCx	2.032±0.30	1.074±0.174
P RCA	2.978±0.39	1.573±0.227
M RCA	2.268±0.46	1.198±0.262
D RCA	1.713±0.49	0.905±0.272

Table 3: Coronary Artery Diameters of Male and Female Patients after Indexing (Adjusted for Individual Patients BSA*)

Coronary artery	Male patients (n = 69)	Female patients (n = 41)	p-value
Left mainstem	2.112±0.174	2.131±0.199	0.612
P LAD	1.855±0.154	1.848±0.194	0.843
M LAD	1.444±0.190	1.469±0.205	0.526
D LAD	0.905±0.176	0.971±0.194	0.078
PLCx	1.660±0.198	1.753±0.283	0.076
D LCx	1.053±0.165	1.124±0.187	0.051
P RCA	1.545±0.205	1.642±0.267	0.050
M RCA	1.170±0.230	1.269±0.323	0.104
D RCA	0.876±0.238	0.978±0.339	0.094

*Indexing was done by dividing diameter of each coronary artery with BSA of individual patient and then mean of indexed diameters of all patients was taken.

diameter of MRCA is larger and diameters of left main, PRCA, MLAD, DLAD and DLCx are smaller in the present study.

Comparison between patients of South Asian origin of Hasan et al. study and present study showed that diameters of PRCA, PLAD, MLAD, DLAD PLCx are larger and diameters of left main and MRCA are smaller in our study (Table 6). Comparison with Caucasians of Hasan et al. study showed that diameters of most of the coronary arteries i.e. PLAD, MLAD DLAD and PLCx are larger in our study and diameters of left main stem and MRCA are smaller in our study.

Diameters of most of the coronary arteries of our study were smaller as compared to Caucasians of Lip et al. study and larger as compared to Caucasians of Hasan et al. study. Due to these contradicting results, comparison of coronary artery diameters of Caucasians of Lip et al. study with Caucasians of Hasan et al. study was done (Table 7) to reveal the true depiction of the comparison. It was found that diameter of left main stem of both studies was similar; diameter of MRCA of Lip et al. study is smaller than Hasan et al. study and diameters of PLAD, MLAD, DLAD, PLCx and PRCA of Caucasians of Lip et al. study are significantly larger than Caucasians of Hasan et. al. study.

DISCUSSION

The diameters of the coronary arteries have been found to be very different in the normal population.[27, 29-30] Genetic factors like, age, gender, weight, BSA, weight and size of the heart and ethnic and racial factors have all been interrelated with the anatomy of coronary arteries in different research studies.[21,15,18,29,31] Most of these researches were either injection studies in post mortem cases or dissection studies. Quite a few associations have been declared on the basis of these studies between heart weight and luminal diameter of the coronary arteries.

In some studies it had been shown that males had larger coronary arteries as compared to females even after indexing with body surface area.[13, 32] In an Indian study the difference between left main stem and DLCx of male and female patients was found to be statistically significant

Table 4: Comparison of Non-Indexed Coronary Artery Diameters of Present Study with Coronary Artery Diameters Reported in Kaimkhani et al. and Faridullah et al Study

Coronary artery	Coronary artery diameter (mean±sd) [present study, n = 110]	Coronary artery diameter (mean±sd) [Kaimkhani et al: Pakistanis, n= 220]	p-value	Coronary artery diameter (mean±sd) [Faridullah et al: Pakistanis (non-diabetics) n*]	p-value
Left mainstem	4.087±0.34	4.28±0.82	0.018	4.18±0.375	0.044
P LAD	3.572±0.31	3.22±0.74	0.000	3.10±0.201	0.000
M LAD	2.751±0.36	----	----	3.14±0.188	0.000
D LAD	1.749±0.33	----	----	2.42±0.393	0.000
PLCx	3.195±0.39	3.02±0.75	0.022	3.02±0.216	0.000
D LCx	2.032±0.30	----	----	2.29±0.426	0.000
P RCA	2.978±0.39	3.08±0.78	0.197	----	----
M RCA	2.268±0.46	----	----	----	----
D RCA	1.713±0.49	----	----	----	----

*Number of patients was different for each vessel and is detailed below
n for left main stem = 138
n for PLAD = 101
n for MLAD = 113
n for DLAD = 126
n for PLCx = 125
n for DLCx = 133

Table 5: Comparison of Indexed Coronary Artery Diameters of Present Study with Diameters Reported in Lip et al. Study for Caucasians and South Asians

Coronary artery	Coronary artery diameter (mean±sd) [present study n = 110]	Coronary artery diameter (mean±sd) [Lip et al: Caucasians n= 77]	p-value	Coronary artery diameter (mean±sd) [Lip et al: Indo-Asians n= 39]	p-value
Left mainstem	2.09±0.211	2.38±0.47	0.000	2.26±0.41	0.001
P LAD	1.884±0.172	1.89±0.37	0.894	1.83±0.34	0.205
M LAD	1.451±0.193	1.68±0.37	0.000	1.57±0.29	0.004
D LAD	0.9242±0.183	1.31±0.32	0.000	1.28±0.31	0.000
PLCx	1.687±0.227	1.71±0.32	0.588	1.71±0.39	0.658
D LCx	1.074±0.174	1.32±0.29	0.000	1.34±0.37	0.000
P RCA	1.573±0.227	1.79±0.39	0.000	1.70±0.39	0.015
M RCA	1.198±0.262	1.06±0.26	0.000	0.97±0.27	0.000
D RCA	0.905±0.272	----	----	----	----

Table 6: Comparison of Indexed Coronary Artery Diameters of Present Study with Diameters Reported in Hasan et al. Study for Caucasians and South Asians

Coronary artery	Coronary artery diameter (mean±sd) [present study n = 110]	Coronary artery diameter (mean±sd) [Hasan et al: Caucasians n= 61]	p-value	Coronary artery diameter (mean±sd) [Hasan et al: South Asians n= 61]	p-value
Left mainstem	2.09±0.211	2.41±0.68	0.000	2.39±0.49	0.000
P LAD	1.884±0.172	1.72±0.44	0.006	1.56±0.45	0.000
M LAD	1.451±0.193	1.33±0.41	0.032	1.21±0.41	0.000
D LAD	0.9242±0.183	0.83±0.26	0.013	0.71±0.26	0.000
PLCx	1.687±0.227	1.53±0.50	0.022	1.59±0.40	0.044
D LCx	1.074±0.174	-----	----	-----	----
P RCA	1.573±0.227	1.57±0.42	0.958	1.42±0.42	0.002
M RCA	1.198±0.262	1.34±0.40	0.014	1.32±0.40	0.017
D RCA	0.905±0.272	----	----	----	----

Table: 7: Comparison of Indexed Coronary Artery Diameters of Caucasians of Lip et al. Study with Caucasians of Hasan et al. Study

Coronary artery	Coronary artery diameter (mean±sd) [Lip et al. Caucasians n = 77]	Coronary artery diameter (mean±sd) [Hasan et al: Caucasians n= 61]	p-value
Left mainstem	2.38±0.47	2.41±0.68	0.770
P LAD	1.89±0.37	1.72±0.44	0.017
M LAD	1.68±0.37	1.33±0.41	0.000
D LAD	1.31±0.32	0.83±0.26	0.000
PLCx	1.71±0.32	1.53±0.50	0.016
D LCx	1.32±0.29	-----	----
P RCA	1.79±0.39	1.57±0.42	0.002
M RCA	1.06±0.26	1.34±0.40	0.000
D RCA	----	----	----

however it was not significant in the case of PLCx, all the three segments of the left anterior descending (LAD), the right coronary artery (RCA).[17] In the present study without indexing, diameter of MLAD was significantly smaller among female patients but after indexing no statistically significant difference was found between males and females. The difference in results may be due to different ethnicity. In another study, comparing coronary artery diameters of diabetic and non-diabetic patients, 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.[33]

Mean body surface area of participants of our study was 1.84±0.187 which is comparable with another Pakistani study which reported mean BSA 1.8004±0.11 and is similar to the BSA (1.88±0.19) of Caucasians of Lip et al.study and is also similar to BSA(1.86 ± 0.20) of South Asians of Hasan et al. study. Although in an Indian study and Asians of Lip et al. study, the mean body surface area was 1.77±0.15 and 1.68 ± 0.17, respectively which was lower than our study.[16,17,20,34]

A study conducted on normal angiograms at Long Island Jewish Medical Center had reported that coronary artery diameters of South Asians are significantly smaller than Caucasians, even after correcting for BSA. Two other studies conducted by Lip et al, and Dhawan et al, had noticed smaller coronary artery diameters in South Asians, but after correcting for BSA the difference was insignificant hence they concluded that the smaller diameter of the coronary arteries in Indo-Asians was due to their comparatively smaller BSA.[16,18] Moreover the study done by Dhawan and Bray simply determined the proximal segments of disease free coronary arteries in male Caucasians and Indo-Asians experiencing cardiac catheterization; they have calculated a total diameter of coronary arteries by adding up the diameters of circumflex, proximal right and left anterior descending arteries.

Another study conducted in India revealed that the dimensions of a few branches in the left coronary arteries were smaller than the mean and indexed diameters of both Indian Asians and Caucasians of Lip et al. study.[16,17] The size of the distal LCx, proxmimal LAD and distal LAD were significantly larger in Indo-Asians residing in the UK while the diameter of proximal and distal RCA were significantly larger in individuals enrolled from India. On comparing indexed diameter of arteries, Left main stem, distal LCx and all other segments of LAD were found to be significantly larger in Caucasians. While diameter of proximal RCA, and distal RCA were significantly larger in subjects enrolled from India.[17]

Results of the present study were similar to the Indian study.[17] On comparing our results with Lip et al. Indo-Asians it was found that the indexed diameter of MRCA was larger and diameters of left main, PRCA, MLAD, DLAD and DLCx were smaller in our study.[16] Comparison of our results with Lip et al. Caucasians showed that diameters of PLAD and PLCx were not different between our study and of Lip et al. study whereas, diameter of MRCA was larger and diameters of left main, PRCA, MLAD, DLAD and DLCx were smaller in the present study.[16]

In a recent study conducted by Hasan et al. it was reported that luminal diameters of proximal LAD were smaller in south Asians as compared to Caucasians even after indexing with BSA.[20] There were no significant differences in left main, mid LAD, left circumflex, or right coronary artery luminal diameters between the two groups.[20]

Results of our study were different from Hasan et al. study.[20] Comparison between people of South Asian origin of Hasan et al. study and present study showed that diameters of PRCA, PLAD, MLAD, DLAD PLCx were larger and diameters of left main and MRCA were smaller in our study.[20] Comparison with Caucasians of Hasan et al. study showed that diameters of most of the coronary arteries i.e. PLAD, MLAD DLAD and PLCx were larger and diameters of left main stem and MRCA were smaller in our study.[20] This finding was contradictory as compared to comparison of our results with Lip et al. study results.[16] On comparison of coronary artery diameters (Caucasians) of Lip et al. study with Hasan et al.[20] study it was found that diameter of left main stem of both studies is similar; diameter of MRCA of Lip et al. study was smaller than Hasan et al. study and diameters of PLAD, MLAD, DLAD, PLCx and PRCA of Caucasians of Lip et al. study were significantly larger than Caucasians of Hasan et al. study.[20] Therefore no standardized data of coronary artery diameters of Caucasians was available for comparison as reported coronary artery diameters of Caucasians of the two above mentioned studies were significantly different from each other.[16,20]

In another study of South Asian and Caucasian men it was found that with comparable demographic and clinical characteristics, luminal diameters of proxmial coronary arteries and CAD severity were similar between the two groups. Similar results were stated by a Pakistani study which reported that the coronary artery diameter of Pakistanis were not different from that of Caucasians and some other causative factors were involved in increased CAD related morbidity and mortality in people of South Asian origin.[14]

LIMITATIONS

The present study had some limitations, firstly, as subjects were enrolled from a tertiary care hospital so results of this study cannot be generalized to the whole population. Secondly, normal coronary angiogarms of subjects presenting with different forms of cardiac problems like ACS,

angina etc were selected and studied, such subjects may not be considered as normal population. However, enrolling apparently healthy volunteers for performing coronary angiography seems to be unethical, impractical, and risky and may actually reveal disease.

CONCLUSION

It was attempted to document the coronary artery size in Pakistani patients having normal angiograms. The present study showed that the coronary artery diameters of some segments of the left stem were smaller than Caucasians of one study (Lip et al.) and larger when compared to Caucasians of another study (Hasan et al.). These two studies also had great variations in coronary artery diameters reported for Caucasians. Standardized and consistent data regarding coronary artery diameters of Caucasians is required, which can then provide more reliable comparison between coronary artery diameters of South Asians and Caucasians.

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