ORIGINAL RESEARCH PAPER

Volume-7 | Issue-7 | July-2018 | PRINT ISSN No 2277 - 8179

INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

AN ANGIOGRAPHIC EVALUATION OF THE NORMAL CORONARY ARTERY DIMENSIONS IN INDIANS

Cardiology

K.nachiappan post graduate in cardiology Institute of cardiology, madras medical college

Balaji Pandian* assistant professor in cardiology Institute of cardiology, madras medical college
*Corresponding Author

N. Swaminathan professor of cardiology Institute of cardiology, madras medical college

ABSTRACT

Background Good knowledge of the expected normal lumen size at a given coronary artery site is the most important first step towards developing a quantitative estimation of coronary artery disease severity. Size of the coronary artery is the most important predictor of outcome after percutaneous coronary interventions (PCI) and coronary artery bypass graft surgery (CABG).

Aim To find out the normal dimensions of the coronary artery segments in Indians without coronary artery disease by using quantitative coronary angiography and also to compare the dimensions in Indians with various studies.

Material and method Out of 1258 patients who have undergone coronary angiography, 62 patients (42 male and 20 female) with entirely normal coronary angiogram were selected in the study. Patients with history of diabetes mellitus, hypertension, renal disease, valvular heart disease, cardiomyopathy were excluded.

Results Diameter of the coronary vessels in males and females when taken together the left main was larger in size followed by proximal LAD, proximal RCA & proximal LCX respectively (4.05 ± 0.14 mm, 3.15 ± 0.14 mm, 2.84 ± 0.84 mm, 2.95 ± 0.91 mm). LAD measurement was 3.15±0.14, 2.95±0.10, 2.41±0.27 mm at proximal LAD, mid LAD & distal LAD. LCX measurement was 2.95±0.91, 2.65±0.56 mm at proximal & distal LCX. RCA measured as 2.84±0.84, 2.50±0.5mm & 2.15±0.56 mm at proximal, mid & distal RCA.

When the proximal vessel diameters were indexed to body surface area there was significant statistical difference between male and female (P value < 0.05). Mean diameters of proximal coronary segments indexed to body surface area of our study when compared to Caucasians (Birmingham study) showed that there was no statistical significant difference (p value > 0.05).

Conclusion Dimensions of proximal coronary segments when indexed to body surface area have statistically significant difference among sex distribution in our population. We found that coronary arteries when indexed to body surface area was not statistically different as compared to western population Caucasians.

KEYWORDS

Coronary angiogram, LAD- left anterior descending artery, LCX- left circumflex artery, RCA- right coronary artery.

STUDY BACKGROUND

Good knowledge of the expected normal lumen size at a given coronary artery site is the most important first step towards developing a quantitative estimation of coronary artery disease severity. Size of the coronary artery is the most important predictor of outcome after percutaneous coronary interventions (PCI) and coronary artery bypass graft surgery (CABG). Several postmortem studies regarding dimensions of coronary arteries are available. Age, sex, anatomic variation, left ventricular hypertrophy or dilatation and body mass index can influence the coronary artery size[1,2]. Only very few data are available about coronary artery dimensions in an Indian population[3,4].

AIM OF THIS STUDY:

To find out the normal dimensions of the coronary artery segments in our population with normal coronary arteries by using quantitative coronary angiography and to compare the coronary dimensions in Indians with various studies.

STUDY METHODS:

Out of 1258 patients who have undergone coronary angiography during the period January 2017 –June 2017 in Rajiv Gandhi General Hospital, Chennai, 62 patients (42 male and 20 female) with entirely normal coronary angiogram based on visual assessment of absence of any luminal irregularities were selected in the study.

Patients with history of diabetes mellitus, hypertension, renal disease, valvular heart disease, cardiomyopathy, abnormal echo report were excluded.

Coronary angiography was performed by femoralor radial route with 5f/6f Judkin's right and left catheter. Selective coronary catheterization was done by standard projections using Philips Xper Flex Cardio Imaging system. Images were acquired for each coronary artery segment in two orthogonal views and the mean of the two values was calculated for statistical analysis. The vessels were assessed in an end diastolic frame.

Measurement of the Quantitative Coronary Angiography (QCA) system was carried out by automated edge detection technique method in which the coronary catheter diameter used for angiography procedure was helpful as the calibrating object for measuring the coronary diameters[5]. No intracoronary nitroglycerin was administered prior to acquisition of images.

Coronary angiograms with evidence of ectasia, localized atheroma, coronary spasm, and previous history of myocardial infarction with reanalyzed arteries were excluded.

All angiograms were reviewed by an experienced interventional cardiologist both for identification of defined normal vessels and the subsequent quantitative coronary artery analysis. All films were again reviewed by a second observer. Both observers were blinded regarding the patient identity and inter-observer variability was accounted for during statistical analysis.

Identification of Target Vessels size[7]

Standard angiographic views[4,8] were obtained and QCA was done on widest possible disease-free normal segments of coronary arteries which were uniformly distended and contrast filled. Only patients with normally looking coronary arteries on angiograms were included for the study. The segments of the coronary arteries analyzed are shown in Figures 1 and 2.

LEFT CORONARY ARTERY SEGMENTS

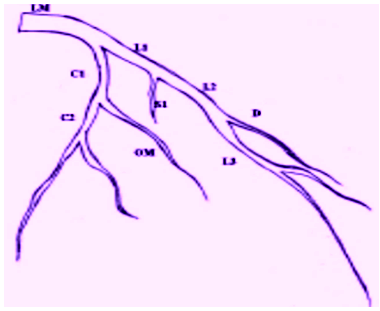

figure1. Segments of left coronary artery - Left Main Coronary Artery (LM), Proximal Left Anterior Descending Artery (L1): before origin of the first septal branch (S). Mid Left Anterior Descending Artery (L2) :between origin of first septal and first diagonal (D) branches. Distal Left Anterior Descending Artery (L3): After the first diagonal artery. Proximal Circumflex (C1): Segment before origin of the first obtuse marginal (OM). Distal Circumflex (C2): Segment after the origin of the obtuse marginal.

RIGHT CORONARY ARTERY SEGMENTS

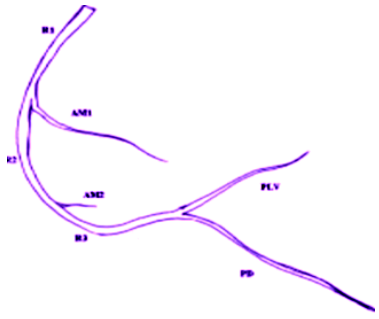

Fig 2. Segments of the right coronary artery - Proximal Right Coronary Artery (R1): Before origin of first acute marginal (AM1). Mid Right Coronary Artery (R2): Between first and second (AM2) acute marginals. Distal Right Coronary Artery (R3): After the second acute marginal branch. Posterior descending artery (PD), Posterior left ventricular branch (PLV)

The dimensions of all coronary artery segments that were measured were indexed to the BSA (body surface area) and compared to the data from Birmingham study which compares the coronary dimension in Indian Asians living in the United Kingdom and the native Caucasian population[5].

STATISTICAL METHODS:

Student 't' test was used for comparison of differences in coronary artery dimensions among males and females. Comparison of mean coronary artery diameter indexed to body surface area between the present study and previous studies was done by the independent 't' test. Statistically significant P value in all these tests was assumed at a value < 0.05.

RESULTS:

In our study we have selected 62 patients out of 1258 patients undergone coronary angiography. About 42 patients were males and 20 were females and the mean age of the patients was 48.45±5.1 years (range 29–71 years). Mean BMI was 24.11 ±0.25 kg/m2 (range 31.30–21.26 kg/m2). Mean body surface area was 1.6± 0.11 m2.

TABLE 1 BASELINE CHARACTERS

Total patients	62 (male 42, female 20)
Mean age	48.45 ± 5.1 (29-71years).
Weight	58.09 ± 8.4 kg
Height	160.03 ± 6.36 cm
BMI	24.11 ± 0.25 kg/m2 .
Body surface area	1.6 ± 0.12 m2
Coronary dominance	
Right coronary artery	32 (52.5%)
codominance	17 (27.4%)
Left coronary artery	13 (20.1%)

Left main	4.05±0.14 mm
Proximal LAD	3.15 ± 0.14 mm
Mid LAD	2.95±0.10 mm
Distal LAD	2.41±0.20 mm
Proximal LCX	2.95 ± 0.91 mm
Distal LCX	2.65±0.96 mm
Proximal RCA	2.84 ± 0.84 mm
Mid RCA	2.50±0.50 mm
Distal RCA	2.15±0.56 mm
Diagonal	1.99±0.76 mm
Obtuse marginal	2.28±0.58 mm

Mean diameter of the left main coronary artery was 4.05 ± 0.14mm. Left anterior descending artery (LAD) mean diameter was found to be 3.15 ± 0.14 mm in proximal part, 2.95 ± 0.10 mm in midpart and 2.41± 0.2 mm in distal LAD. Large diagonal artery has 1.99 ± 0.7 mm mean diameter. Left circumflex artery (LCX) mean diameter was 2.95 ± 0.91 mm in proximal part and distal LCX was 2.65 ± 0.56 mm. Large Obtuse marginals diameter was 2.28 ± 0.58 mm. Right coronary artery had following mean dimensions (proximal RCA 2.84 ±0.84 mm, mid RCA 2.5 ± 0.5 mm and distal RCA – 2.15 ± 0.56 mm).

Mean diameters of proximal segments of coronary artery system were larger in males compared to females reference to the BSA. Our study showed that when the size of the proximal vessel, was indexed to the BSA, there was statistical significant difference between males and females (P value <0.05)(TABLE 2).The coronary dimensions when indexed to body surface area of left main, proximal LAD, proximal RCA and proximal LCX were 2.5±0.36 mm, 1.93 ± 0.19 mm, 1.8±0.16 mm and 1.80 ±0.18 mm respectively.

TABLE 2, COMPARISION OF CORONARY DIMENSIONS (PROXIMAL PARTS) AMONG MALES AND FEMALES

	Male(mm)	Indexed to BSA male(mm/m2)	female(mm)	Indexed to BSA female(mm/m2)	P
Left main	4.06± 0.26	2.52± 0.32	3.93 ±0.21	2.48 ± 0.52	0.001
Proximal LAD	3.18 ± 0.19	1.98± 0.42	3.04 ±0.18	1.92 ± 0.43	0.001
Proximal RCA	2.96 ± 0.16	1.84 ± 0.24	2.58 ±0.15	1.62 ± 0.35	0.001
Proximal LCX	3.10 ± 0.18	1.93± 0.51	2.76 ± 0.17	1.71 ± 0.43	0.001

The proximal vessel size indexed to body surface area in the present study was compared to other studies to find if there was a significant difference. It was found that the diameters of proximal coronary segments indexed to body surface area of our study when compared to Caucasians (Birmingham study), showed no statistical significant difference (p value > 0.05) (table 3).

TABLE 3, COMPARISION OF MEAN CORONARY ARTERY DIAMETER (PROXIMAL PARTS) INDEXED TO BODY SURFACE AREA WITH OTHER STUDIES

Coronary dimensions indexed to body surface area mm/m2	Present study n-62 M:F 42:20	AIIMS study11 n-94 M:F 63:31	Birmingham study (Caucasians) 5n-77 M:F 39:38	P value Birmingham study
Left main	2.43±0.26	2.16±O.42	2.38±0.47	0.45
Proximal LAD	1.93±0.19	1.69±0.37	1.89±0.37	0.44
Proximal LCX	I.80±0.18	1.67±0.37	1.71±0.32	0.06
Proximal RCA	1.80±0.16	1.83±0.39	1.79±0.38	0.06

In our study, the diameters of the left main, proximal LAD, proximal LCX and proximal RCA indexed to body surface area are greater than Caucasians in BRIMINGHAM study (TABLE 3).

DISCUSSION

In the normal population the dimensions of the coronary arteries are highly variable[5]. Genetic factors, age, sex, body weight, body surface area, weight of the heart and ethnic and racial factors all have a role with the coronary artery anatomy in various studies. Quantitative coronary angiography (QCA) aims at geometric as well as functional evaluation of coronary artery stenosis. Dhavan et.al[6] and Skelton.NT et. al[13] have validated the accuracy of digital quantitative estimation of coronary dimensions.

In our study, coronary artery size was greater in the male patients as compared to females in the both left and right coronary system.

Elangovan et al[8] and O Connor NJ et al[9] found that females have smaller coronary diameters after adjusted to BSA similar to our study findings. Barendrakumar raut et al[10] found that female have equal size coronaries when indexed to BSA. Cheemalapatti saikrishna et al[11] published that male patients had greater diameters in left coronary system. Our study also showed male patients had larger diameters.

Dhall et al[12] and J. T Dodge, B G Brown et al[14] analyzed coronaries and also found females had smaller coronaries.

Occlusion or thrombosis is more common in vessels less than 2.5 mm in diameter[5]. A moderate (60%) stenosis in a 2.5 mm vessel would have more obstructive effects on flow than the same degree of stenosis in a 3.5 mm diameter vessel as the cross sectional area in the former would be reduced than the latter.

Lip et al[5]. and Dhawan et al[6] reported that unadjusted angiographically estimated mean coronary artery diameters of western population Caucasians were higher than Indians and it was not significant when dimensions of coronaries are indexed to body surface area.They concluded that the smaller diameter of the coronaries in Indian Asians is attributable to their smaller body surface area.

In our study also coronary dimensions of Indians are larger than Caucasians. When proximal vessels diameters are indexed to BSA, there was no statistical significant difference (P>0.05) when compared to caucasians.

CONCLUSION

The dimensions of proximal coronary segments when indexed to body surface area has statistically significant difference among sex distribution in our population. Coronary artery size when indexed to body surface area was not statistically different as compared to western population Caucasians.

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