e-ISSN: 0975-9506, p-ISSN: 2961-6093

Available online on www.ijpqa.com doi: 10.25258/ijpqa.16.12.69

International Journal of Pharmaceutical Quality Assurance 2025; 16(12); 414-420

Original Research Article

Left Main, Proximal LAD & LCX Arteries Dimensions in Indian Population: An IVUS Study

Nilashish Dey

Senior Resident, Dr NB (Resident), Department of Cardiology, Fortis Escorts, Heart Institute, New Delhi, India

Received: 11-10-2025 / Revised: 12-11-2025 / Accepted: 21-12-2025
Corresponding Author: Dr. Nilashish Dey
Conflict of interest: Nil

Abstract:

Background: The dimensions of coronary arteries differ in different populations and determine the accuracy of diagnosis and outcome after interventional procedures. There is limited data on the coronary measurements of the Intravascular Ultrasound (IVUS) in Indians in spite of the high incidence of coronary artery diseases.

Objective: To assess IVUS-measured dimensions and plaque burden of Left Main (LM), proximal Left Anterior Descending (LAD), and proximal Left Circumflex (LCX) arteries in an Indian population and determine clinical determinants.

Methodology: The study was a prospective observational study involving 150 adults who underwent IVUS-guided coronary angiography between 2022-2023. ANOVA was used to compare the vessel diameters with the plaque burden and the clinical variables to identify the predictors of the arterial dimensions and the effect of coronary dominance.

Result: LM demonstrated the greatest diameter (4.77 +- 0.63 mm) and the greatest plaque burden (49%). The LAD was 3.58 +- 1.41 mm and the LCX was the smallest (0.83 +- 1.63 mm). Women Hypertension and body surface area were significant predictors of LM size; age and BSA were significant predictors of LCX size; no factors had an effect on LAD dimensions. There was also an influence of coronary dominance on the distribution of plaque, with right circulation being related to a higher LAD plaque burden and left/co-dominance correlating with greater LCX involvement.

Conclusion: IVUS displays different patterns of coronary dimensions and preponderation based on plaque in Indian patients. These results can be used to offer the population-specific reference values and offer the strategies of coronary intervention to the individual.

Keywords: IVUS, Indian population, coronary dimensions, left main artery, LAD, LCX, plaque burden, coronary dominance.

This is an Open Access article that uses a funding model which does not charge readers or their institutions for access and distributed under the terms of the Creative Commons Attribution License (http://creativecommons.org/licenses/by/4.0) and the Budapest Open Access Initiative (http://www.budapestopenaccessinitiative.org/read), which permit unrestricted use, distribution, and reproduction in any medium, provided original work is properly credited.

Introduction

Ischemic heart disease (IHD) has remained one of the greatest challenges to the overall health of the global population and its effects are especially significant in low- and middle-income nations, the Indian state being no exception. The IHD is the leading cause of death among all cardiovascular diseases (CVD), with almost a quarter of all deaths caused by CVDs in the country [1]. This frightening burden is not only due to the increasing number of traditional risk factors that include hypertension, diabetes, dyslipidemia, tobacco and sedentary lifestyles but also the combination of genetic predisposition and rapid socio-economic changes that take place in the Indian subcontinent. There is an urgent need to optimize diagnostic and intervention approaches which can enhance the cardiovascular outcomes among this population as clinical and economic outcomes of IHD continue to widen.

The intrinsic anatomy of the coronary vasculature is a major determinant of the course of the natural history of coronary artery disease (CAD) as well as the outcome of coronary revascularization. The size of coronary vessels within the general population is largely variant to an inter-individual variation affected by a range of demographic and anthropometric components as well as genetic based variations, together with the environment [2,3]. The size of the vessels can vary widely depending on age, sex, body surface area, ethnicity and other co-occurring pathophysiological conditions. Coronary arterial dimensions can therefore only be accurately measured to make the best clinical decisions, procedural plans, and prognostication in CAD. This applies more so in the left main coronary artery (LMCA) and its great vessels namely the proximal left anterior descending (LAD) and left circumflex (LCX) arteries which serve a significant percentage of left ventricular

myocardium. Even minor errors in the process of estimating their sizes can have far-ranging effects to the revascularization methods and outcomes.

Percutaneous translation lumbar coronary intervention (PCI) and coronary artery bypass grafting (CABG) are the foremost modalities of coronary revascularization of obstructed CAD in patients. But the success of both the process in the long run depends greatly on proper determination of the vessel size. Reliable dimensional evaluation is a key aspect in the correct selection of stent diameter and length, lesion preparation, and optimization of post-deployment in PCI. The possible consequences of stent under-sizing are mal-sizing, incomplete coverage of the lesion and early or late stent thrombosis, whereas the consequences of stent over-sizing include vessel dissection, redistribution of plaque or perforation. On the same note, proximal vessel calibre familiarity is the most important factor in CABG planning to select the most appropriate conduit and to predict technical challenges. Therefore, the accurate determination of vessel geometry is the foundation of evidence-based coronary revascularization [4].

The most commonly used modality of coronary anatomy assessment is still coronary angiography. As much as angiography gives a two-dimensional luminogram, which has been the diagnostic mainstay of CAD decades long, it is not without significant limitations. In particular, angiography can only visualize the contrast filled lumen, and it cannot allow direct assessment of the arterial wall, plaque burden, or actual vessel size, which are crucial parameters needed to understand the severity of the lesion and interventions. These are particularly stronger restrictions in the case of left main coronary assessment. Accurate angiographic evaluation of the LMCA could be hampered by a number of anatomical and technical factors. Streaming or loss of visualization at the ostium due to opacification by the aortic cusp next to it [5] can occur. The LMCA is usually short in nature and as such limits the availability of reference segments at or near lesion location. Moreover, the bifurcation/trifurcation of the distal LMCA may hide the critical information about vessel sizes as per angiographic projection. Such limitations have the tendency to produce high inter-observer and intra-observer errors when interpreting angiography which brings issues of reliability to the dimensions produced by QCA.

The use of intravascular ultrasound (IVUS) has become a strong intracoronary imaging technology that circumvents most of the shortcomings of traditional coronary angiography. Being one of the tomographic methods, which can be used to visualize not only lumen but the vessel wall, IVUS can also deliver high-resolution real-time cross-sectional images that can be used accurately to characterize the vessel geometry, the plaque morphology, the severity of the lesion, and the stent-vessel interactions. It has been widely confirmed as a better quantitative device than angiography in the measurement of the dimension of the coronary in diseased and normal vessels [6]. Measures of lumen area, external elastic membrane (EEM) area, and plaque burden obtained using IVUS have been demonstrated to have a greater association with histological measurements and clinical results.

The clinical utility of IVUS is all the way through the scope of PCI, including pre-procedural planning and post-procedural optimization. IVUS allows a more precise stent sizing and choice of interventional strategy through a more detailed study of the distribution of plaque, length of lesion, and the size of the vessel, before intervention. IVUS provides strut-level evaluation of stent expansion, apposition and edge cuts following the placement of stents and enables maneuvering to optimize the stent in vivo environment to reduce complications. The observational findings randomized clinical location, and meta-analyses of evidence consistently show that IVUS-guided PCI leads to lower cases of stent thrombosis, restenosis, recurring revascularization, and major adverse cardiac events than angiography-guided PCI [7]. Consequently, IVUS guidance has become a part and parcel of modern-day best practice in complex PCI, especially left main intervention.

Due to the procedural and prognostic importance of correct vessel measurement, determination of normative reference values of coronary artery dimensions has enormous clinical importance. The information on population-specific coronary dimensions is especially useful in the treatment of diffuse coronary disease, in which angiographic reference segments are unavailable or unreliable. Normative data assist interventional cardiologists to determine the size of the stents that should be used even when the direct visualization of healthy segment is not feasible. This plays a pivotal role in avoiding technical difficulties related to poor selection of stents that include stent mal-expansion, edge cuts, restenosis and stent thrombosis. In addition, ethnic or regional differences in coronary anatomy and their population-specific vessel metrics might be reflected and utilized in designing devices, interventional approaches, and risk prediction models.

Although India has a big and varied population, there are few reports on normal dimensions of the coronary arteries, particularly the ones determined using high-resolution imaging systems like IVUS. The majority of the current reference values are based on the population of the West, which has anthropometric and genetic characteristics much different compared to those of the Indian population. Application of western data to Indian patients may thus lead to improper sizing of stents, and poor PCI outcomes. However, with the high load of CAD in India, the growing use of IVUS-guided PCI, there is

a need to develop normative IVUS-derived coronary dimensions in Indian population. Specifically, careful analysis of left main, proximal LAD, and proximal LCX anatomy can be considered helpful benchmarks that lead to the improvement of clinical practice and improve the safety of the procedure.

The present study aims to address the existing knowledge gap by assessing the dimensions of the left main coronary artery and its major branches in an Indian cohort using IVUS. By generating population-specific normative data, this study seeks to improve understanding of coronary anatomy in Indian individuals and support more precise, evidence-based coronary interventions.

Methodology

Study Design: This study was designed as a prospective observational study aimed at evaluating the dimensions of the left main coronary artery (LMCA), proximal left anterior descending artery (LAD), and left circumflex artery (LCX) using Intravascular Ultrasound (IVUS) in an Indian population. The study sought to document luminal and vessel dimensions and explore associations with demographic and clinical variables.

Study Area: The study was conducted at Fortis Escorts Heart Institute, New Delhi, a tertiary-care cardiac centre equipped with advanced diagnostic and interventional facilities, including high-resolution IVUS systems. The hospital serves as a major referral centre for patients undergoing coronary angiography and intravascular imaging.

Study Duration: The study was carried out over a period of two years, from 2022 to 2023. All enrolled patients were followed from admission until discharge.

Study Population: The study population consisted of adult patients diagnosed with coronary artery disease (CAD) who were scheduled for elective coronary angiography (CAG) and underwent IVUS-guided CAG as part of their clinical evaluation.

Sample Size: Sample size estimation was based on the study by Barendra Kumar Raut et al., which reported the mean LMCA diameter as 4.08 ± 0.44 mm. Using a 1-sample t-test, a significance level of $\alpha = 0.05$, a power of 80%, and assuming a clinically meaningful difference of 0.10 mm, the required sample size was calculated as 154 participants.

Due to feasibility and time-bound constraints, 150 patients were ultimately enrolled during the study period, which remains adequately powered for detecting clinically relevant differences.

Inclusion Criteria:

Participants were eligible if they met the following criteria:

- Adults aged 18 years or older
- Diagnosed with coronary artery disease
- Undergoing IVUS-guided coronary angiography
- Provided written informed consent

Exclusion Criteria

Patients were excluded if they had:

- Severe arrhythmias or unstable angina
- Contraindications to IVUS or coronary angiography
- Acute myocardial infarction
- Significant valvular heart disease
- Hemodynamic instability
- Pregnancy or lactation
- History of severe allergy to contrast agents

Data Collection: Standardized case report forms were used to collect the data to make the process uniform and reliable. The systematically collected demographic and clinical data included the age, sex, body mass index (BMI), the body surface area (BSA) and comorbid conditions (hypertension (HTN) and type 2 diabetes mellitus (T2DM). IVUS imaging had detailed measurements of LMCA, proximal LAD and LCX dimension. The procedure recorded all IVUS-based measurements of the arteries such as lumen diameter, vessel area, and plaque characteristics, which were subsequently confirmed by the trained observers.

Procedure: The IVUS guided coronary angiography was performed on all eligible patients employing normal interventional procedures that are available at the study center. Vascular access was created either over the radial or the femoral artery where a guiding catheter was placed at the left coronary ostium. A catheter of IVUS was then pushed over coronary guidewire into the LMCA and proximal segments of LAD and LCX. Automated pullback imaging was done to get high-resolution cross-sectional images of the vessel lumen and wall. All the measurements were obtained at end-diastole to reduce variation. The analysis of IVUS images after the procedure was done offline by highly qualified cardiologists to maintain accuracy and reproducibility of the vessel dimension measurements.

Ethical Considerations: The Institutional Review Board (IRB) approved the study protocol, so the ethical standards concerning human research were observed. Informed consent was informed and taken in writing before all subjects were enrolled with all the details given about the study procedure, risks, and benefits. All patient-related information, including confidentiality, was strictly followed and data anonymized during the analysis with the storage of the information being restricted to avoid unauthorized access to it.

Statistical Analysis

Minitab(r) version 19 was used in statistical analysis. Continuous variables were reported in the form of mean +- standard deviation (SD), and categorical variables were reported in the form of frequencies and percentages. The independent t-test was applied to compare the continuous variables and the chi-square test, or the Fisher exact test was applied to categorical variables under appropriate circumstances. The relationship between the size of the coronary arteries and a range of demographic or clinical variables, and the comparison of plaque burden in the circumstances of the coronary dominance patterns were analyzed with the application of analysis of variance (ANOVA). All statistical analyses were deemed significant at a p-value of below 0.05.”

Result

Table 1 presents the baseline data of the cohort of study participants, and most of them are older adults with a mean age of 70.09 +- 9.98 years, and the majority of the population is male (81.33%). The average BMI of the respondents was 32.74 +-4.36 kg/m2 and the mean body surface area was 1.91 +-0.13m2 which showed that the body mass was generally high. Cardiovascular risk factors were very high with 54% stating that they had a family history of CAD, 42% were smokers, 50.67% had type 2 diabetes, and 47.33% had hypertension which represents a cohort with a high level of cardiometabolic comorbidity.

Table 1: Baseline Characteristics of the Study Participants

Variable	Mean ± SD / n (%)
Age (years)	70.09 ± 9.98
Male	122 (81.33%)
Female	28 (18.67%)
Height (cm)	159.20 ± 6.22
Weight (kg)	82.74 ± 9.92
BMI (kg/m²)	32.74 ± 4.36
BSA (m²)	1.91 ± 0.13
Family history of CAD	81 (54.00%)
Smoking	63 (42.00%)
T2DM	76 (50.67%)
Hypertension	71 (47.33%)

Table 2 outlines the dimension and pattern of coronary dominance of arteries within the study population. The largest diameter (4.77 +- 0.63 mm) and the greatest plaque burden (49.01 +- 15.11%) were on the Left Main (LM) artery. The proximity LAD was 3.58 +- 1.41 mm and the plaque burden was 44.85 +- 22.08% whereas the proximal LCX had a much lower mean diameter (0.83 +- 1.63 mm) and the least plaque burden (11.18 +- 22.75%). Coronary dominance was right dominant (79.33 percent) then left dominant (15.33 percent) and co-dominant (5.33 percent), which revealed that the majority of the individuals had a circulation pattern favoring the supply of the right coronary artery.

Table 2: Arterial Dimensions and Coronary Dominance

Parameter	Mean ± SD / n (%)
LM diameter (mm)	4.77 ± 0.63
LM plaque burden (%)	49.01 ± 15.11
Proximal LAD diameter (mm)	3.58 ± 1.41
LAD plaque burden (%)	44.85 ± 22.08
Proximal LCX diameter (mm)	0.83 ± 1.63
LCX plaque burden (%)	11.18 ± 22.75
Right-dominant	119 (79.33%)
Left-dominant	23 (15.33%)
Co-dominant	8 (5.33%)

Table 3 presents ANOVA results that demonstrate factors related to the dimensions of coronary arteries in major segments. In the case of Left Main (LM) artery, hypertension and body surface area (BSA) were found to be significant predictors (p = 0.044 and 0.043), but age, sex and type 2 diabetes mellitus (T2DM) did not have any significant effect. Age and BSA had a significant impact (p = 0.004 and 0.040) in the Left Circumflex (LCX) artery, whereas sex and T2DM did not have any relationship. It is important to note that in the case of the Left Anterior Descending (LAD) artery, none of the variables considered age, sex, hypertension, T2DM, or BSA significantly predicted the vessel dimensions, showing that there was a more consistent pattern of arterial anatomy regardless of the clinical or demographic variables.

Table 3: Significant Predictors of Coronary Artery Dimensions (ANOVA Summary)			
Artery Segment	**Significant Predictors**	**p-value**	**Non-significant Predictors**
Left Main (LM)	Hypertension, BSA	0.044, 0.043	Age, Sex, T2DM
Left Circumflex (LCX)	Age, BSA	0.004, 0.040	Sex, T2DM
Left Anterior Descending (LAD)	None	—	Age, Sex, T2DM, HTN, BSA

Table 4 illustrates the changes in the plaque burden (PB) between the left main (LM), left circumflex (LCX), and left anterior descending (LAD) arteries, based on the coronary dominance. Even though the LM plaque burden did not significantly differ in dominance patterns (p = 0.36), the values were varying between 44.38 percent in co-dominant systems and 49.89 percent in right-dominant systems. Strikingly, however, there was a significant difference between LCX plaque burden according to dominance (p = 0) with right-dominant system demonstrating significantly lower PB (3.8%) than left-dominant (38.91%) and co-dominant (41.25) schemes. There was also a significant difference in the LAD plaque burden (p = 0), the highest was in the right-dominant circulation (48.89%), moderate in the co-dominant (42.5%), and lowest in the left-dominant systems (24.78%), which underlies the robust role of coronary dominance on vessel-specific atherosclerotic localization.

Table 4: Plaque Burden (%) According to Dominant Coronary System			
Artery	**Dominance**	**Mean PB (%)**	**p-value**
LM	Co-dominant	44.38	0.36
LM	Left-dominant	46.09	
LM	Right-dominant	49.89	
LCX	Co-dominant	41.25	**0**
LCX	Left-dominant	38.91	
LCX	Right-dominant	3.8	
LAD	Co-dominant	42.5	**0**
LAD	Left-dominant	24.78	
LAD	Right-dominant	48.89	

Table 5 summarizes the key findings of the study, showing that right coronary dominance was most common (79.33%), and the left main (LM) artery had the largest vessel diameter (4.77 ± 0.63 mm). The LM also exhibited the highest plaque burden (49.01%), followed by the left anterior descending artery (LAD) at 44.85%. Hypertension and body surface area (BSA) were identified as significant determinants of LM dimensions, whereas age and BSA influenced LCX dimensions; no specific factors were associated with LAD dimensions. Coronary dominance patterns also affected plaque distribution, with right-dominant circulation linked to the highest LAD plaque burden, while left and co-dominant patterns showed greater plaque burden in the LCX.

Table 5: Summary of Key Findings	
Domain	**Summary**
Most common coronary dominance	Right-dominant (79.33%)
Largest vessel	Left Main (4.77 ± 0.63 mm)
Highest plaque burden	LM (49.01%), followed by LAD (44.85%)
LM dimension determinants	HTN, BSA
LCX dimension determinants	Age, BSA
LAD dimension determinants	None
Dominance effect	Right-dominant → highest LAD PB; Left/Co-dominant → highest LCX PB

Discussion

The current results can add valuable population-specific data on the dimensions of coronary arteries in the Indian population and support the physiological and pathological trends in previous intravascular ultrasound studies. The left main (LM) diameter was relatively large in our cohort, and it follows the structural requirements of this vessel, but the values were significantly greater than those in a few angiographic and IVUS-based studies, which may indicate ethnic differences, or it may be due to increased cardiovascular risk burden. As an example, Rupali et al., (2022) [8] and Fazliogullari et al., (2010) [9] have recorded lower LM diameter values, of 4.52 mm and 4.44 mm on average, and in a cineangiographic study, MacAlpin et al., (1973) found even lower values [10]. Our average LM diameter,

conversely, was higher than these figures by a significant margin that could be attributed to the advanced age, the participants having higher BMI, and having more hypertension-inducing factors- factors that have been known to cause compensatory vascular enlargement. The fact that our findings are similar to those of Dhakal et al., (2015) [11] who found LM diameters of 4.38 +- 0.49 mm in Nepalese population, adds further evidence to the fact that an anatomical trend exists within the South Asian population, and our slightly higher values could be due to more intense atherosclerotic remodeling."

The LAD dimensions in our article were fairly constant among demographic groups, which is contrary to other studies like Reddy et al., (2019) who reported the ages and BSA to be positively associated with proximal LAD size in North Indian participants [12]. This deviation could suggest that the LAD is a highly shear stressed and hemodynamically critical vessel and responses more conservatively to systemic risk factors in some subgroups. On the other hand, age and BSA played a significant role in determining LCX dimensions in our cohort, which was similar to the SYNTAX-based results by Sianos et al., (2005) that reported the vulnerability of LCX segments to atherosclerotic due to age [13]. This concordance indicates that structural features of LCX may be more susceptible to processes of systemic vascular aging as compared to the LAD.

Hypertension became one of the most important determinants of LM dimensions in our population, which is comparable to the results of Candemir et al., (2012) who proved that hypertension predisposes positive arterial remodelling even in vessels that have no severe stenosis on the angiography [14]. This compensatory enlargement is emphasized by our findings, which probably represent chronic wall stress and intimal-medial hypertrophy-mechanisms that could conceal underlying plaque buildup when measurements are based on angiographic lumen visualization alone. The finding that LM or LAD dimensions do not significantly correlate with diabetes is contrary to other studies such as the research carried out by Jimenez-Quevedo et al., (2009) that reported progressive shrinkage of vessels in diabetics in serial IVUS imaging [15]. The causes of these disparities might be differences in glycemic control, duration of disease or antidiabetic therapy, since our cohort was not adequately stratified by diabetes severity.

One of the main contributions of our study is that we have managed to clarify the correlation between coronary dominance and plaque distribution. The greater burden of LAD plaque in right-dominant individuals is consistent with the results of the PROSPECT study, which found a greater atherosclerotic burden of the LAD in individuals with right domination due to varying loads of perfusion and flow (Stone et al., 2011) [16] [16]. In the meantime, the high LCX plaque burden in left-dominant and co-dominant patterns is in line with the fact that LCX become significant when supplying a larger myocardial territory- in fact, in the SYNTAX cohort, dominant LCX-involvement made revascularization efforts difficult (Sianos et al., 2005) [13]. Practically our observation that there were no significant differences in LM plaque burden among dominance groups agrees with other researchers Ge et al., (1994) who investigated that LM atherosclerosis is more affected by systemic risk load than by dominance specific variations [7].

Our IVUS data related to QCA-based analyses support the well-known principle that IVUS always measures more vessel diameter as a result of its capacity to see the external elastic membrane. The studies by Goel, et al., (2021) that find correlation between the results of QCA and IVUS using predictive formulas further explain how angiography tends to underestimate the true size of a vessel [18]. This diagnostic shortcoming is emphasized by our observation of markedly large relative to ostensibly suitable lumen size plaque burden and the need in interventional planning to use IVUS, especially in LM and proximal LAD lesions where stent sizing and lesion preparation are vital to long-term success.

Lastly, our population also had typical gender disparities in crude coronary dimensions, where men had greater absolute arterial dimensions but again this disparity was not significant when indexed to BSA just as found in Dhawan et al., (1995) and Elangovan et al., (2005) who stressed the necessity to adjust the coronary sizes of different sexes through anthropometric adjustment [19, 20]. This strengthens the idea that there should be interpretation of vessel sizes based on individual body habitus and not using absolute values.

Altogether, the similarity and differences between our results and the previous literature suggest that population-specific anatomy, burden of risk factors, and coronary dominance are relevant in defining the coronary artery structure and the behavior of plaque. This paper highlights the importance of IVUS to determine actual vessel sizes and the role of IVUS in interpreting regional coronary pathology differences to underscore its extended application in both diagnostic and interventional decision-making.

Conclusion

This paper has shown that intravascular ultrasound measurement of the left main artery, proximal LAD, and proximal LCX arteries of an Indian cohort reveals significant differences in vessel dimensions and plaque distribution, which indicate significant anatomical and clinical variability among this group. The results suggest that body surface area and hypertension are some of the patient features that have an effect on the size of specific coronary segments, whereas the others are not significantly related to

coronary remodeling, highlighting the heterogeneous character of coronary remodeling. The disparity in burden of the plaque in the patterns of dominance also further amplifies the contribution of the coronary anatomy in atherosclerotic burden, indicating that dominance might be a factor in segment predisposition. In general, the research has a thorough understanding of the morphology of coronary arteries and plaque in Indian patients that can serve as good reference information to improve accuracy in diagnosing, conduct a risk analysis, and design interventional in this group.

References

1. Prabhakaran D, Jeemon P, Roy A. Cardiovascular diseases in India: current epidemiology and future directions. Circulation. 2016 Apr 19;133(16):1605-20.
2. Hermiller JB, Cusma JT, Spero LA, Fortin DF, Harding MB, Bashore TM. Quantitative and qualitative coronary angiographic analysis: review of methods, utility, and limitations. Catheterization and cardiovascular diagnosis. 1992 Feb 1;25(2):110-31.
3. Restrepo C, Eggen DA, Guzman MA, Tejada C. Postmortem dimensions of the coronary arteries in different geographic locations. Laboratory investigation; a journal of technical methods and pathology. 1973 Feb;28(2):244-51.
4. Takayama T, Hodgson JM. Prediction of the physiologic severity of coronary lesions using 3D IVUS: validation by direct coronary pressure measurements. Catheterization and cardiovascular interventions. 2001 May;53(1):48-55.
5. Mintz GS, Nissen SE, Anderson WD, Bailey SR, Erbel R, Fitzgerald PJ, Pinto FJ, Rosenfield K, Siegel RJ, Tuzcu EM, Yock PG. American College of Cardiology clinical expert consensus document on standards for acquisition, measurement and reporting of intravascular ultrasound studies (ivus) A report of the american college of cardiology task force on clinical expert consensus documents developed in collaboration with the european society of cardiology endorsed by the society of cardiac angiography and interventions. Journal of the American College of Cardiology. 2001 Apr;37(5):1478-92.
6. van Zandvoort LJ, Tovar Forero MN, Masdjedi K, Lemmert ME, Diletti R, Wilschut J, de Jaegere P, Zijlstra F, Van Mieghem NM, Daemen J. References for left main stem dimensions: a cross-sectional intravascular ultrasound analysis. Catheterization and Cardiovascular Interventions. 2019 Feb 1;93(2):233-8.
7. Ge J, Erbel R, Gerber T, Görge G, Koch L, Haude M, Meyer J. Intravascular ultrasound imaging of angiographically normal coronary arteries: a prospective study in vivo. Heart. 1994 Jun 1;71(6):572-8.
8. Rupali Mahajan B1, Atul Atmaram A2, Preeti Meshram et al Variations in coronary artery diameter: a retrospective observational study in Indian population. Heart Vessels Transp 2022; 6:
9. Fazliogullari Z, Karabulut AK, Unver Dogan N, Uysal II. Coronary artery variations and median artery in Turkish cadaver hearts. Singapore J Med 2010; 51: 77580.
10. MacAlpin RN, Abbasi AS, Grollman JH, Eber L. Human coronary artery size during life. A cinearteriographic study. Radiology 1973; 108: 567–76.
11. Dhakal A, Shrestha RN, Maskey A, Pandey S. Coronary artery dimensions in the Nepalese population. J Anat Soc India 2015; 64: 27–31
12. Sreenivas Reddy, Suraj Kumar, Jeet Ram Kashyap, et al, Coronary artery size in North Indian population – Intravascular ultrasound-based study, Indian Heart Journal, Volume 71, Issue 5, 2019, Pages 412-417,
13. Sianos G, Morel MA, Kappetein AP, et al. The SYNTAX score: an angiographic tool grading the complexity of coronary artery disease. EuroIntervention. 2005; 1:219-227.
14. Candemir B, Ertas FS, Ozdol C et al Effect of hypertension on coronary remodeling patterns in angiographically normal or minimally atherosclerotic coronary arteries: an intravascular ultrasound study. Clin Exp Hypertens. 2012;34:432-8
15. Jiménez-Quevedo P, Suzuki N, Corros C, et al. Vessel shrinkage as a sign of atherosclerosis progression in type 2 diabetes: a serial intravascular ultrasound analysis. Diabetes. 2009; 58:209-14
16. Stone GW, Maehara A, Lansky AJ, et al. A prospective natural-history study of coronary atherosclerosis. New England Journal of Medicine. 2011; 364: 226-235.
17. Goel PK, Liladhar Vora P, Kumar Sahu A, Khanna R. Left main coronary artery diameter - A correlation between intravascular ultrasound and quantitative coronary angiography. Indian Heart J. 2021; 73:660-663.
18. Dhawan J, et al. Are Asian coronary arteries smaller than Caucasian: a study on angiographic coronary artery size estimation during life. Int J Cardiol. 1995; 49:267–269.
19. Elangovan C, Jaganathan V, alageshan R, et al. Clinical and anthropometric correlation of normal Coronary artery dimensions. Indian Heart J. 2005; 57:381–425