OPEN ACCESS
Freely Available Online

JOURNAL OF HYPERTENSION AND CARDIOLOGY
ISSN NO: 2329-9487

Research

DOI: 10.14302/issn.2329-9487.jhc-21-3754

Variations in Diameter of the Left Coronary Artery and its Main Branches among Adult Population of Khartoum State, Sudan

Muntaser Alhassen[1], Abuzer Abdalla[2,*], Tahir Ali[3], Mohamed Akeel[2]

[1]Department of Anatomy, Faculty of Applied Medical Sciences, Jazan University, Jazan, Saudi Arabia

[2]Department of Anatomy, Faculty of Medicine, Jazan University, Jazan, Saudi Arabia

[3]Department of Anatomy, Faculty of Medicine, The National Ribat University, Khartoum, Sudan

Abstract

The main left coronary artery and its branches have wide variability in its morphology regarding caliber, as seen through angiographic imaging. This study aims to determine the diameters of the left coronary artery and its branches among the Sudanese population & to correlate these diameters and the personal and health data. Angiography of 441 patients of both sexes was used in this study. Personal and health information was obtained from the records. We found that the left coronary artery's diameter was between 2.90- 4.90mm, with an average of 3.96mm. The diameter of the left circumflex artery in the range between 1.70- 4.70mm, with an average of 2.73mm, and that of the anterior descending artery in the range between 1.20- 4.70mm, with an average of 2.78mm. We correlated the diameters of the three arteries and the variables of age, gender, BMI, coronary artery disease, smoking habits, and hypertension. We found many correlations to be significant. We concluded that the diameters of the left coronary artery and its branches are affected by age, gender, BMI, coronary artery disease, smoking habits, and hypertension.

Corresponding author: Abuzer Abdalla, 3850 King Fahad St., El Shati District, Unit 57, Jazan 82716, Kingdom of Saudi Arabia

Keywords: Left coronary artery, Left circumflex artery, Anterior descending artery Angiography, BMI, Coronary artery disease, Smoking habits, Hypertension.

Received: Feb 23, 2021 **Accepted:** Mar 09, 2021 **Published:** Mar 11, 2021

Editor: Sanjiv Sharma, Chairman, Dept of Medicine Director, Research and Education Chairman, Health Education and CME Committee Interventional Cardiologist, United States.

Introduction

The great advances in managing patients with coronary artery diseases enable treatment of these patients to be guided by coronary artery angiogram. Such improvement in the angiographic analysis is required to allow more effective application of information that depends on the coronary angiograms for the patients' diagnosis and therapy with ischemic coronary syndromes[1]. There is great variability in the dimensions of the coronary arteries in the average population[2]. The study of coronary artery variations, especially the left main coronary artery, can help the clinician plan interventional procedures such as stenting, balloon dilatation, or graft surgery.[3] The main left coronary artery (MLCA) is shorter and larger than the right coronary artery [4]. Usually, it is the first vessel to show blockages. It has a wide variability in its morphology regarding caliber, length, and the number of branching from the main trunk. These variations should be considered, not as anatomical characteristics only but also in interpreting different clinical events and the corresponding intervention maneuvers. The left coronary artery's mean diameter was reported to range from 3.0 to 6.8mm (4.64 ± 1.03)[5]. These wide variations are present in different branching patterns. The variation is also due to the effect of ethnicity, gender, age groups, and health condition. There is a lack of reports about the diameters of the left main coronary artery and its branches in the Sudanese population. This study covers this part and also contributes to the worldwide reports in this field. The objective of the study is to determine the angiographic diameters of the main left coronary artery, the left circumflex artery, and the anterior descending artery. It also aims to set a correlation between the diameters of these arteries and other variables like age, sex, surface area, and health problems.

Materials and Methods

This is a descriptive retrospective study of coronary angiography. The participants were 441 patients of both sexes. All the patients were above 18 years old and all without congenital heart diseases. Those patients were visitors of 3 Heart Centres in Khartoum State, Sudan. In each patient, a catheter was inserted, and dye was injected into coronary arteries, and X-Ray images were taken from different angles. Measurements of the diameters of the left coronary artery, the left circumflex artery, and the anterior descending artery were taken by 2 independent readers, with negligible variability. Ethical approval was obtained from the Heart centers, and history of personal data and health status was collected from the records. Mean, and standard deviation was calculated for each reading. ANOVA, Mann–Whitney *U,* and t-Tests were used to calculate the correlations (*p*-value of .05 or less was considered significant).

Results

General Personal & Clinical Data

A total of 441 patients were included in this study. The general personal data were taken through history, clinical examination, and previous records. Items in descriptive statistics include age (range 43-68years), gender (189males and 252females), BMI (normal:84, overwt:147, obese:210), smoking habit (168 smokers and 273 non-smokers), hypertension (420 hypertensive and 21 normotensives), and coronary diseases (421 diseased and 20 non).

Diameters of the Left Coronary Artery and its Main Branches

The angiography of these arteries is illustrated in Fig 1.

The angiographic measurement of the left coronary (LC) diameter was found in the range between 2.90- 4.90mm, mean 3.96, and Std. Dev. 0.549mm. The left circumflex artery's diameter was found in the range between1.70- 4.70mm, mean 2.73 and Std. Deviation .687mm. The diameter of the anterior inter-ventricular artery was found in the range between 1.20-4.70mm, mean 2.78, and Std. Deviation .825mm. these diameters are blotted in the graph(1).

Correlations with Personal & Clinical Variables

Correlations of the diameters with age, sex, BMI, smoking, hypertension, and coronary diseases are shown in table 1 below.

Discussion

This study provided insight into the diameters of the left coronary artery (LCA) and its main branches in 441 cases. Measurements were collected from Coronary

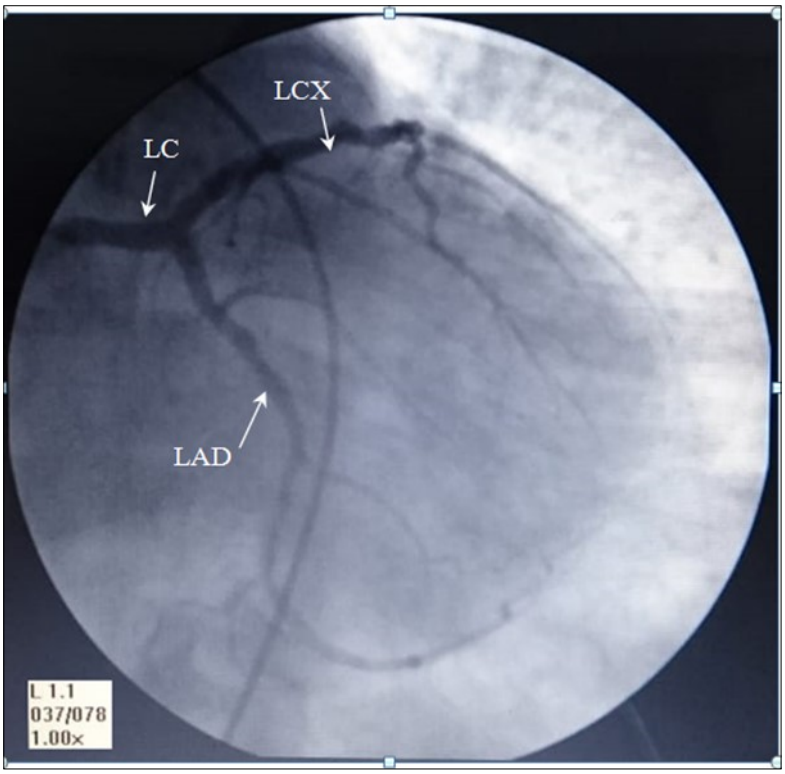
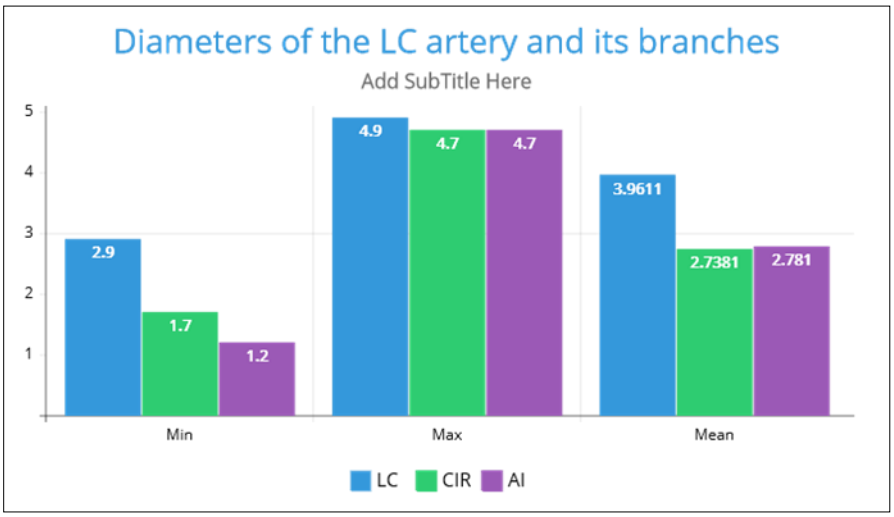


Figure 1. AP- anteroposterior angiographic view showing, *Left coronary artery*: LC, *left anterior interventricular (anterior descending) artery*: LAD, *and Left Circumflex artery:* LCX



Graph 1. The average diameter of the left coronary (LC) artery, the left circumflex artery (CIR), and anterior interventricular (anterior descending) artery (AI)

Table 1. left coronary (LC) artery, left circumflex artery (CIR), and anterior interventricular artery (AI); *p*-value of .05 or less was considered significant (EX.SIG: extremely significant, V.

Variable: test	Age: ANOVA	Sex: T-Test	BMI: ANOVA	Hypertension: Mann–Whitney *U* test	Smoking: T-Test	coronary diseases: T-Test
LC: p. value	.000 EX.SIG	0.738 N.SIG	.001 V.SIG	.000 EX.SIG	.001 V.SIG	.000 EX.SIG
CIR: p. value	.000 EX.SIG	0.094 N.SIG	.239 N.SIG.	.000 EX.SIG	.000 EX.SIG	.121 N.SIG.
AI: p. value	.000 EX.SIG	0.003 V.SIG	.000 EX.SIG.	.000 EX.SIG.	.000 EX.SIG.	.020 SIG

SIG: very significant, SIG: significant), *p*-value of more than .05 are stated as. N.SIG

angiography, supported by personal and clinical data where relevant. The left coronary artery (LCA) diameter in this study was found in the range between 2.90 to 4.90mm, with an average of 3.96 mm for Sudanese. The (LCA) average lumen diameter of the (LCA) was reported 4.4± 0.4mm in an American study[6], 3.8±0.8 mm in an African study [5], and 4.64 ± 1.03 mm in an Indian study[3]. The diameters of the left circumflex artery (CIR) and anterior interventricular (descending) artery (AI) in Sudanese were found to be 2.74 and 2.78 on average, respectively. This could be compared to an American report of 3.6±0.73. And 7±0.5 respectively[7]. The size of coronary vessels is influenced by factors such as age, sex, body weight, body surface area, weight of the heart, and ethnicity/race[8]. However, it was reported that there was no correlation between the length of the LCA and its diameter; it also showed no correlation between the diameter of the LCA and its angle of division[9]. In our study, most of the factors such as ethnicity, gender, age, and health conditions have a significant effect on the variations of the diameters of the three arteries, with p-value less than .05. Exceptions were the sex effect on (LCA) and (CIR), BMI effect on (CIR), and coronary diseases effect on (CIR), which seemed to have less significant effects. In 1992 a study from South Africa [5] reported no statistically significant difference between sexes (p= 0.696). This was true for Sudanese in our study regarding the (LCA) and (CIR), but could not be applied to the (LI). However, another study from New England, only one year later from that of South Africa, stated that the mean luminal diameters of the coronary arteries were larger among men than among women[10]. The definition of the severity of coronary arterial narrowing depends on proper knowledge of the range of the average size of the coronary arterial tree[11]. It has been reported that patients with small vessels are at a higher risk of having an adverse outcome following coronary stent placement due to a higher incidence of re-stenosis [12]. In coronary artery bypass surgery, the most important factor in predicting the success of the operation is the size of the vessel to which the bypass is anastomosed [13]

Hypertension in our study has a highly positive effect on the diameter of the left coronary artery. It may be on all coronary circulation, although a previous study on multivariate analysis demonstrated that hypertension has less effect [14]. The BMI and obesity likewise may have effects on coronary vessels variable with body effort and level of stress, but, despite increased technical difficulty caused by obesity, it is not an independent risk factor [15]. The effect of coronary artery disease on the diameter of the main left coronary artery. It may be on the other coronary vessels could be explained by the significant changes in resting and

reactive hyperemic coronary flows and resting pressure gradients occurred as the length of a given degree of narrowing of the artery was increased [16].

Conclusion

Measurements of the diameters of the Left Coronary Artery (LCA), the left circumflex artery, and the anterior descending artery revealed much variations among the Sudanese population. The variations are due to age, gender, BMI, coronary artery disease, smoking habits, and hypertension.

References

1. Johnson MR. A normal coronary artery: what size is it? Circulation. 1992;86(1):331-3.
2. Saikrishna, C.; Talwar, S.; Gulati, G. & Kumar, A. S. Normal coronary artery dimensions in Indians. IJTCVS, 22:159-64, 2006.
3. Rahalkar AM, Rahalkar MD. Pictorial essay: Coronary artery variants and anomalies. The Indian journal of radiology & imaging. 2009;19(1):49.
4. Ballesteros L, Ramirez L. Morphological expression of the left coronary artery: a direct anatomical study. Folia morphologica. 2008;67(2):135-42.
5. Ajayi, N. O., Lazarus, L., Vanker, E. A., & Satyapal, K. S. (2013). Anatomic Parameters of the Left Coronary Artery: an Angiographic Study in a South African Population. International Journal of Morphology, 31(4).
6. Dharmendra P, Anitha T, Madan S. Clinically significant anatomical variations of the left coronary artery in human cadaveric hearts. International Journal of Current Research and Review. 2013;5 (12):39.
7. Leung, W. H.; Stadius, M. L. & Alderman, E. L. Determinants of normal coronary artery dimensions in humans. Circulation,84(6):2294-306, 1991.
8. Dodge, J. T. Jr.; Brown, B. G.; Bolson, E. L. & Dodge, H. T. Lumen diameter of normal human coronary arteries. Influence of age, sex, anatomic variation, and left ventricular hypertrophy or dilation. Circulation, 86(1):232-46, 1992.
9. Fox, C., Davies, M. J., & Webb-Peploe, M. M. (1973). Length of left main coronary artery. British heart journal, 35(8), 796.
10. O'connor GT, Morton JR, Diehl MJ, Olmstead EM, Coffin LH, Levy DG, et al. Differences between men and women in hospital mortality associated with coronary artery bypass graft surgery. The Northern New England Cardiovascular Disease Study Group. Circulation. 1993;88(5):2104-10.
11. Vieweg, W. V.; Alpert, J. S. & Hagan, A. D. Caliber and distribution of normal coronary arterial anatomy. Cathet. Cardiovasc. Diagn., 2(3):269-80, 1976
12. Elezi, S.; Kastrati, A.; Neumann, F.; Hadamitzky, M.; Dirschinger, J. & Schömig, A. Vessel Size and Long-Term Outcome After Coronary Stent Placement. Circulation, 98(18):1875-80, 1998.
13. Abrams, H. L. Coronary Arteriography: Pathologic and Prognostic Implications. AJR Am. J. Roent-genol., 139(1):1-18, July, 1982.
14. Hees, P. S., Fleg, J. L., Lakatta, E. G., & Shapiro, E. P. (2002). Left ventricular remodeling with age in normal men versus women: novel insights using three-dimensional magnetic resonance imaging. The American journal of cardiology, 90(11), 1231-1236.
15. McClish, J. C., Ragosta, M., Powers, E. R., Barringhaus, K. G., Gimple, L. W., Fischer, J., ... & Samady, H. (2004). Effect of acute myocardial infarction on the utility of fractional flow reserve for the physiologic assessment of the severity of coronary artery narrowing. The American journal of cardiology, 93(9), 1102-1106.
16. Vassiliades Jr, T. A., Nielsen, J. L., & Lonquist, J. L. (2003, January). Effects of obesity on outcomes in endoscopically assisted coronary artery bypass operations. In Heart Surg Forum (Vol. 6, No. 2, pp. 99-101).