

# Length of Left Anterior Descending (LAD) Coronary Artery in Relation to Right & Left Dominancy: A Retrospective Computed Tomographic (CT) Coronary Angiographic Study

Issam Tariq Abdul Wahaab<sup>1</sup>, Sherif Abou Gamra<sup>2</sup>, Fatma Magdy Mohamad Salama<sup>2</sup>, Khaleel A. Hadi<sup>3</sup>

<sup>1</sup>Department of Anatomy, Faculty of Medicine, Baghdad University

<sup>2</sup>Department of Radiodiagnosis, Faculty of Medicine, Ain Shams University

<sup>3</sup>X-ray Institute, Medical City Directorate, Baghdad, Iraq

\*Corresponding author: Issam Tariq Abdul Wahaab, E-mail: dr.issam76t@gmail.com

## ABSTRACT

**Background:** the LAD artery supplies blood to a large part of the myocardium. However, the amount of myocardium supplied varies depending on the length of LAD artery and as a result; occlusion at different portion may influence perfusion of different part of myocardial.

**Objective:** to estimate the length of LAD artery and its possible relationship with the coronary arterial dominance pattern.

**Patients and Methods:** in this study we retrospectively compared 50 coronary CT angiograms of patients with left coronary dominance with 50 coronary CT angiograms of patients with right coronary dominance

**Results:** it revealed that there was a significant relationship between the length of LAD artery and the pattern of dominancy since the P- Value appeared to be  $< 0.001$ .

**Conclusion:** length of LAD artery appeared to be dependent on the dominance pattern and it was taller in left coronary dominant pattern.

**Keywords:** Length of LAD, Coronary dominance

## INTRODUCTION

The arterial blood supply to the heart is achieved by two coronary arteries and their branches. The right and left coronary arteries arise from aortic sinuses of valsalva at the beginning of ascending aorta and then descend in right and left atrioventricular grooves respectively. The left anterior descending and circumflex arteries are the main branches of the left coronary artery whereas the acute marginal and posterior interventricular arteries arise from the right coronary artery<sup>(1)</sup>.

The term dominance is used to describe the anatomical pattern of coronary arteries. Dominant vessel is the one that supplies the posterior diaphragmatic portion of interventricular septum and the diaphragmatic portion of left ventricle. So the dominant vessel refers to the coronary artery which gives the posterior descending artery<sup>(2)</sup>.

The LAD artery supplies blood to a large part of the myocardium. However, the amount of myocardium supplied varies depending on the length of LAD artery and as a result; occlusion at different portion may influence perfusion of different part of myocardial<sup>(3)</sup>.

LAD artery was categorized into three types<sup>(4)</sup>:

- Type I: LAD terminated before the cardiac apex.
- Type II: LAD reached the apex of the heart

- Type III: LAD wrap around the apex and supplied the inferoapical segment.

## AIM OF THE WORK

To estimate the length of LAD artery and its possible relationship to the coronary dominance pattern.

## PATIENTS AND METHODS

This study was conducted in Ain-Shams hospitals and other private centers in which we retrospectively compared 50 CT coronary angiograms of patients with left coronary dominance with 50 CT coronary angiograms of patients with right coronary dominance in the period between 1<sup>st</sup> of January 2017 to 1<sup>st</sup> of January 2018.

A sample of one hundred young adult male patients, aged 40-60 years, who underwent coronary CT angiograms and found to have normal angiograms based on visual assessment of absence of any luminal irregularities, was chosen. While those patients with history of renal diseases and cardiomyopathies were excluded. The collected sample was divided into two equal groups with right and left dominance patterns.

In this study we categorize LAD artery into the following:

1- LAD artery reached the cardiac apex but didn't wrap around it.

2- LAD artery reached the cardiac apex and wrap around it to reach the inferior myocardial wall. The entire cases were examined by using Optima GE 128 CT scanner and Philips Brilliance 64 CT Scanner. Images were interpreted depending on:

- 1- The coronary artery which gave rise to the posterior descending artery (PDA) was regarded as dominant one.
  - a- If the PDA arose from the right coronary artery, then it was a right dominant pattern.
  - b- If the PDA arose from the left coronary artery, then it was a left dominant pattern.
- 2- Whether LAD artery didn't reach, reached or reached and wrap around the cardiac apex.
  - a- If it didn't reach the cardiac apex, then it was a type I LAD artery.
  - b- If it reached the cardiac apex but didn't wrap around it, then it was a type II LAD artery.
  - c- If it reached and wrap around the cardiac apex, then it was a type III LAD artery.

**Statistical analysis**

The collected data analyzed using SPSS software and the variables were expressed as frequencies and percentages. In addition the data were analyzed by Chi square test to study the relationship between length of LAD artery and dominance pattern of coronary arteries. A P value <0.05 will be considered statistically significant.

**Ethical Considerations:** This research would not expose patient to further risk. Patient informations were treated with complete confidentiality and no one has the right to access them except the main investigator, director and co-director of the study. **The study was approved by the Ethics Board of Ain Shams University.**

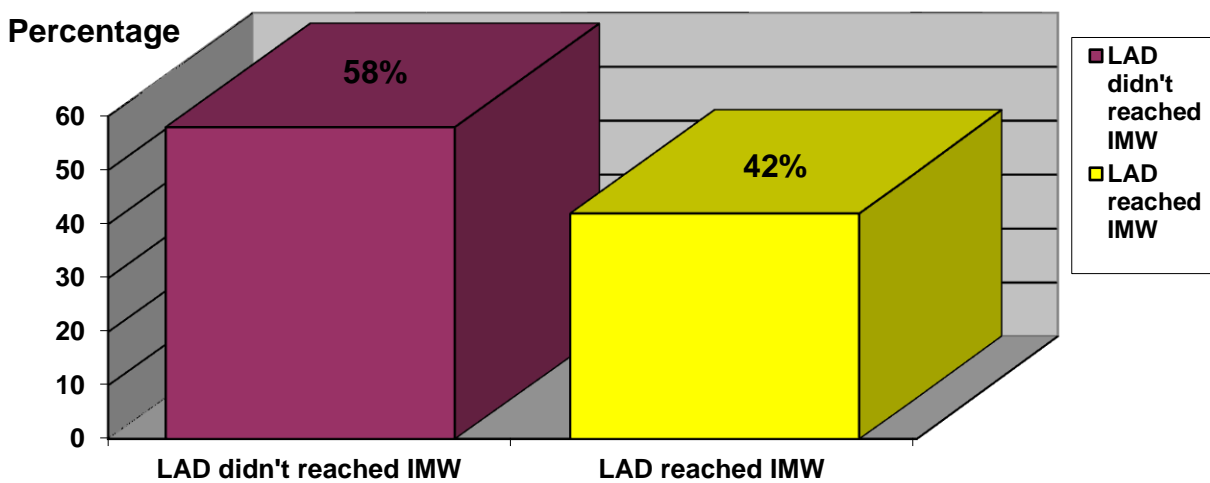
**RESULTS**

**1. Descriptive statistics** is performed to evaluate the frequencies and percentages of different patterns of appearance of LAD in the following:

a- The right dominant coronary CT angiograms (table 1): There was only 42% of the LAD artery reached the apex of the heart and wrap around it to reach the inferior myocardial wall (IMW) (Fig. 1) while the rest 58% of cases in which LAD artery didn't wrap around the apex of the heart and didn't reached the IMW.

**Table 1:** shows the frequencies and percentages of different patterns of appearance of LAD artery in the IMW in the right dominant coronary CT angiograms

LAD	Frequency	percentage
Didn't reach IMW	29	58%
Reached IMW	21	42%
Total	50	100%

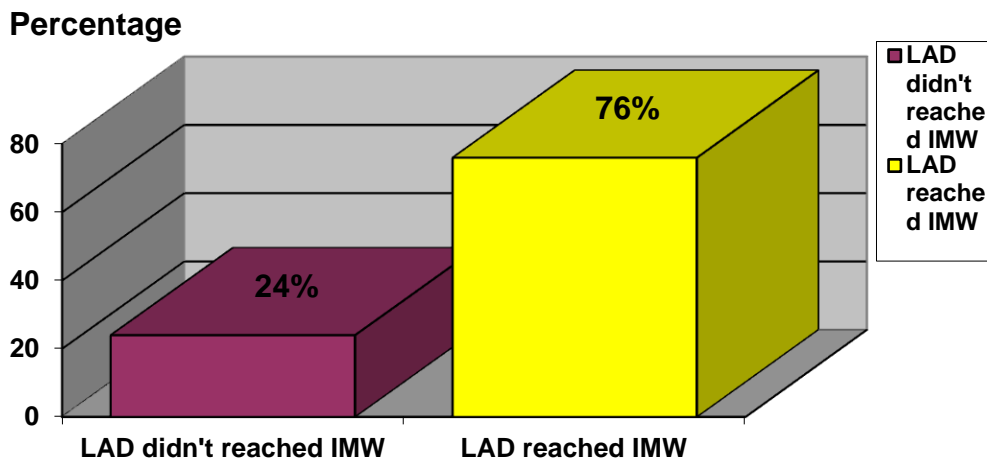


**Fig. 1:** Bar chart shows the frequencies and percentages of different patterns of appearance of LAD artery in the IMW in the right dominant coronary CT angiograms.

**b-** The left dominant coronary CT angiograms (table 2): There was 76% of the LAD artery reached the apex of the heart and wrap around it to reach the IMW (Fig. 2) while the rest 24% of cases in which the LAD artery didn't wrap around the apex of the heart and didn't reached the IMW.

**Table 2:** shows the frequencies and percentages of different patterns of appearance of LAD artery in the IMW in the left dominant coronary CT angiograms

LAD	Frequency	Percentage
Didn't reach IMW	12	24%
Reached IMW	38	76%
Total	50	100%



**Fig. 2:** Bar chart shows the percentages of different patterns of appearance of LAD artery in the IMW in the left dominant coronary CT angiograms

**2. Analytic statistics:** This was conducted by performing Chi-square test to evaluate the relationship between the length of LAD artery and the pattern of dominance of the coronary arteries and whether it is statistical significant or not (table 3).

**Table 3:** shows the relationship between the length of LAD artery and the pattern of coronary arteries dominance.

Dominancy	LAD		Total	P-Value
	Didn't reach IMW	Reach IMW		
Right	29	21	50	0.001
Left	12	38	50	
Total	41	59	100	

Chi square test revealed that there was a highly significant relationship between the length of LAD and the pattern of dominance since the P- Value appeared to be  $< 0.001$ . Therefore; the length of the LAD artery was dependent on the dominance pattern (i.e. length of LAD depends on which of the two main coronary arteries is the dominant one). Thus length of LAD artery was appeared to be taller in left coronary dominant pattern.

**Case presentations:** All cases were chosen to be young adult males aged between 40-60 years, who had CT coronary angiograms and were found to have normal CT coronary angiograms based on visual assessment of absence of any luminal irregularities.

Case number (1): Right dominant coronary CT angiogram shows LAD type II.

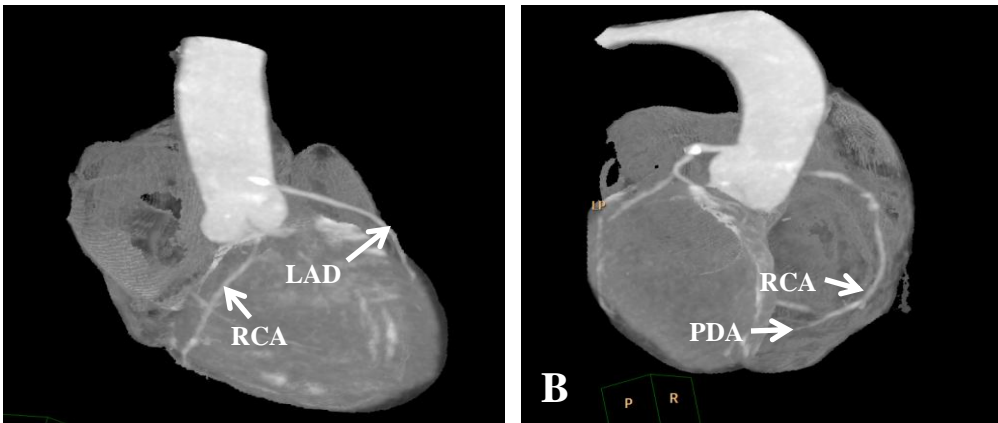


Fig. 3: Maximum intensity projections show: A) LAD type I didn't reach the cardiac apex and B) PDA artery arises from the RCA in a right dominant pattern.

Case number (2): Right dominant coronary CT angiogram shows LAD type II.

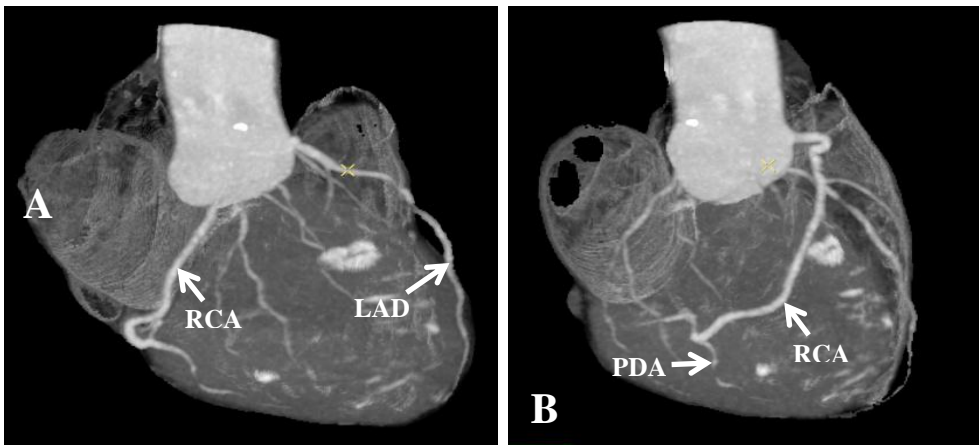


Fig. 4: Maximum intensity projections show A) LAD type II reaching the cardiac apex but didn't wrap around it and B) PDA artery arising from the RCA in a right dominant pattern.

Case number (3): Right dominant coronary CT angiogram shows LAD type III.

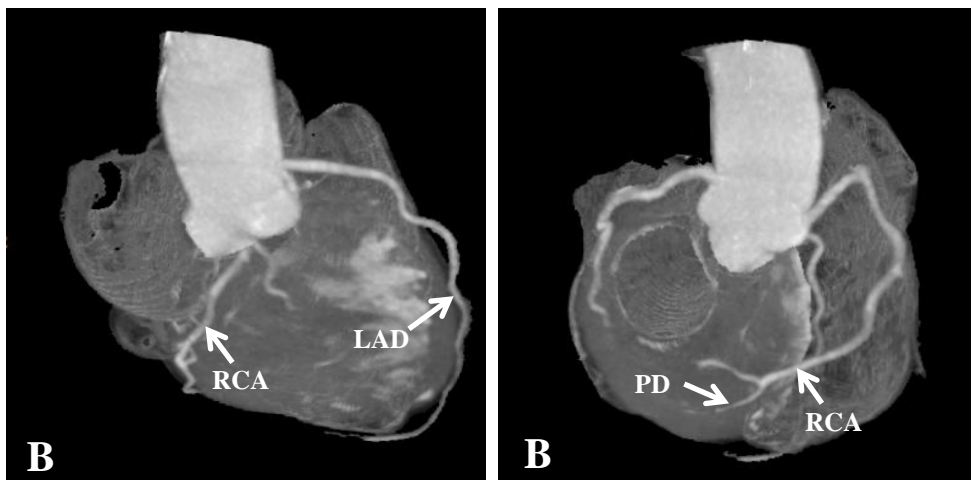


Fig. 5: Maximum intensity projections show A) LAD type III reaching the cardiac apex and wrap around it and B) PDA artery arising from the RCA in a right dominant pattern.

Case number (4): Left dominant coronary CT angiogram shows LAD type II.

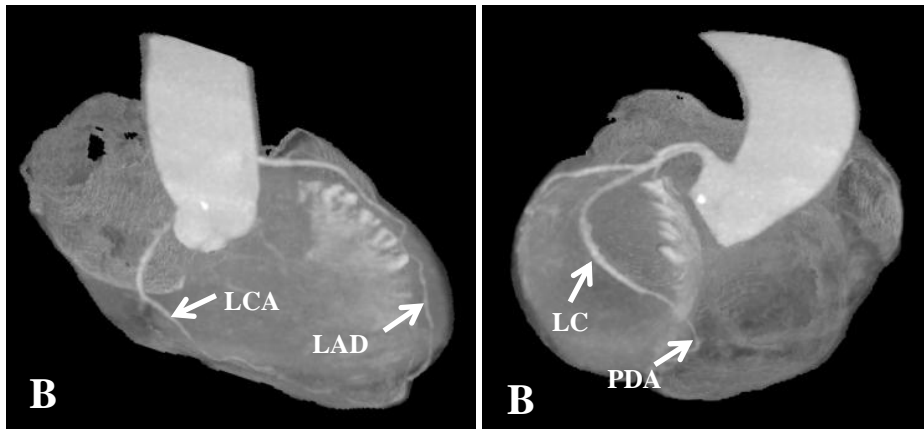


Fig. 6: Maximum intensity projections show A) LAD type II reaching the cardiac apex but didn't wrap around it and B) PDA artery arising from the LCA in a left dominant pattern.

Case number (5): Left dominant coronary CT angiogram shows LAD type III.

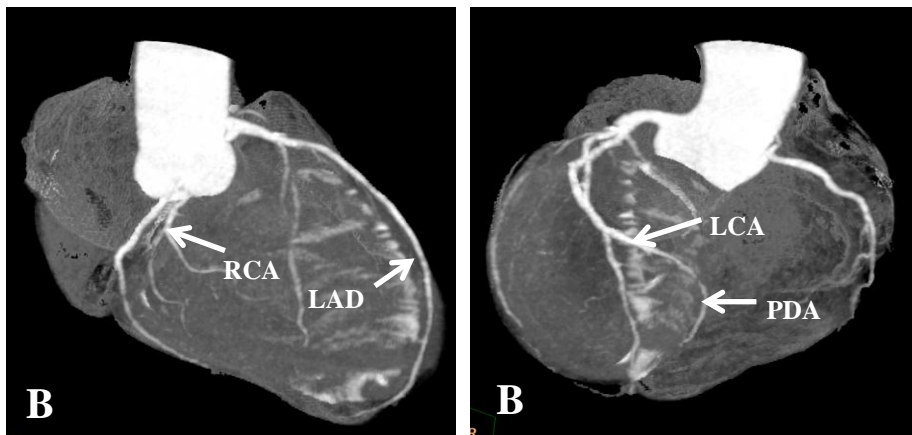


Fig. 7: Maximum intensity projections show A) LAD type III reaching the cardiac apex and wrap around it and B) PDA artery arising from the LCA in a left dominant pattern.

## DISCUSSION

The entire cases were chosen to be young adult male aged between 40-60 years since differences in the ages; gender and race directly affect dimensions of the coronary arteries. According to Dhawan and Bray (5), there was a significant racial difference in the dimensions of the coronary arteries. **Kucher *et al.*** (6) stated that in the general population women had smaller coronary artery dimensions than men. Also Shukri *et al.* (4) reported that there was significant difference in the diameters of the coronary arteries between males and females as the diameters of the coronary arteries appeared to be larger in men when compared with that of the women and this was clearly evident especially with left main coronary artery, proximal left anterior descending artery and

the left circumflex artery. In addition **Ilayperuma *et al.*** (7) found that the mean coronary arterial diameters were significantly smaller in females than in males. These differences persisted even after the diameters of coronary arteries were corrected for heart weight and body surface areas.

The cases were chosen to have normal CT coronary angiograms and this was based on visual assessment of absence of any luminal irregularities while those patients with history of renal diseases and cardiomyopathy were excluded. These depend on the results mentioned by **Kucher *et al.*** (6) that tell the Coronary artery dimensions should not be assessed in symptomatic patients using angiographically measured cross-sectional lumen area, since it may be underestimated in patients with

diffuse coronary artery narrowing, where the luminal area is significantly smaller than would be expected in the absence of coronary artery disease in addition to that patients with left ventricular hypertrophy and dilated cardiomyopathy, coronary artery caliber is larger than in patients with normal left ventricular mass, but may be too small in relation to myocardial bed size.

In spite of the absence of the radiological views in the multidetector computed tomography, since all slices are taken in the axial plane and the final images depend on the postprocessing technique, the obtained images were said to be taken in views simulating right anterior oblique with cranial angulation and anteroposterior view with caudal angulation. **Faletra et al.** <sup>(8)</sup> mentioned that the accurate visualization of coronary artery anatomy by invasive coronary angiography requires coronary injections in multiple views in order to ensure that all coronary segments can be imaged clearly without foreshortening or overlap.

Therefore; in the present study these finding had been taken into consideration in order to have a sample with the most reliable criteria and to minimize the probability of error that may occur due to improper sampling.

Though previous studies used coronary angiographic catheterization to measure the coronary artery dimensions, in this study the work had been performed by using the multidetector 64 CT scanner. **Arbab-Zadeh and Hoe** <sup>(9)</sup> reported in their work that numerous clinical studies have documented high diagnostic accuracy of current generation MDCT. Therefore; coronary angiography using multidetector computed tomography is used increasingly for evaluation of coronary anatomy and ruling out obstructive coronary disease in symptomatic patients. There was 58% of the LAD artery in the right dominant coronary CT angiograms didn't wrap around the apex of the heart with the remaining 42% pass to the posterior interventricular groove in the inferior surface of the heart, while in the left dominant coronary CT angiograms the reverse was found with the highest percentage of LAD wrap around the apex of the heart to reach the inferior myocardial wall in 76% of cases and the remaining 24% didn't wrap around the apex of the heart and didn't reach the inferior myocardial wall. These results came in harmony with the study conducted by **Shukri et al** <sup>(4)</sup> that came out with the result of LAD reached beyond the apex of the heart in majority of cases followed by LAD which reached the apex of the heart but didn't pass to the posterior

interventricular groove and finally came the LAD artery type I with the least percentage. Similarly **Ilia et al.** <sup>(10)</sup> found that the LAD artery in left coronary dominance is usually long and wrap around the apex of the heart. Thus, one of the cardinal points to be taken into consideration regarding the anatomical importance of the LAD is its length. When the LAD wrap around the apex, it supplies a larger mass of myocardium than when it is short and terminates before or at the apex of the left ventricle.

#### CONCLUSION

The length of LAD artery appeared to be dependent on the dominance pattern (i.e. length of LAD artery depends on which of the two main coronary arteries is the dominant one). Thus length of LAD artery was appeared to be taller in left coronary dominant pattern.

#### REFERENCES

- 1- **Gray H, Williams P and Bannister L (1999):** Gray's anatomy. 38th ed. New York: Churchill Livingstone.
- 2- **Brandenburg (1989):** *Cardiology*. Chicago: Year Book Medical Publ., pp.47-112.
- 3- **Ilia R, Weinstein J, Wolak A, Gilutz H and Cafri C (2014):** Length of left anterior descending coronary artery determines prognosis in acute anterior wall myocardial infarction. *Catheterization and Cardiovascular Interventions*, 84(2): 316-320.
- 4- **Shukri IG, Hawas JM, Karim SH and Ali IKM (2014):** Angiographic study of the normal coronary artery in patients attending Sulaimani center for heart diseases, *European Scientific Journal*, 10 (24): 384-415.
- 5- **Dhawan J, and Bray C L (1995):** Are Asian coronary arteries smaller than Caucasian? A study on angiographic coronary artery size estimation during life. *International journal of cardiology*, 49(3): 267-269.
- 6- **Kucher N, Lipp E, Schwerzmann M, Zimmerli M, Allemann Y and Seiler C (2001):** Gender differences in coronary artery size per 100 g of left ventricular mass in a population without cardiac disease. *Swiss medical weekly*, 131(41-42): 610-615.
- 7- **Ilayperuma I, Nanayakkara B and Palahepitiya K (2011):** Sexual Differences in the Diameter of Coronary Arteries in an Adult Sri Lankan Population. *International Journal of Morphology*, 29(4): 1444-1448.
- 8- **Faletra F, Pandian N and Ho S (2009):** *Anatomy of the Heart by Multislice Computed Tomography*. Chichester: John Wiley & Sons, pp. 88-95.
- 9- **Arbab-Zadeh A and Hoe J (2011):** Quantification of coronary arterial stenoses by multidetector CT angiography in comparison with conventional angiography: methods, caveats, and implications. *JACC: Cardiovascular Imaging*, 4(2): 191-202.
- 10- **Ilia R, Rosenshtein G, Marc Weinstein J, Cafri C, Abu-Ful A and Gueron M (2001):** Left anterior descending artery length in left and right coronary artery dominance. *Coronary Artery Disease*, 12(1): 77-78.