



Main Trunk of Left Coronary Artery: Anatomy and Clinical Implications

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ABSTRACT

Introduction: Recognition of the length and variant branching pattern of LMCA is important because it may cause technical difficulties during coronary catheterization and stenting.

Methods: The Length and divisions of main trunk of left coronary artery (LMCA) were studied in patients who underwent coronary angiography for suspected coronary artery disease or for coronary intervention at a tertiary care centre in North India.

Results: The mean age of patients was 57.37 ± 10.60 years (Range 22-92 years). Long LMCA was observed in 16.41% cases and short main trunk in 9.06% cases. Division of main trunk into left anterior descending artery (LAD), left circumflex (LCx) and median artery was observed in 16% cases.

Discussion: Significant association is present between long LMCA and right dominance.

Keywords: coronary artery; coronary artery disease; coronary intervention.

INTRODUCTION

The left main coronary artery presents wide variability in its morphology with regard to length and the number of branches of its trunk. The LMCA divides in several ways; it bifurcates, producing the LAD branch and the LCx branch or trifurcates, producing LAD, LCx and a median branch.¹The left coronary artery supplies not only most of the left ventricle, but also a considerable portion of the right ventricle. Even in cases of extreme right coronary artery dominance, however, the right coronary artery almost always supplies less than 50% of the ventricular myocardium.² Patency of the left coronary artery is therefore vital for sufficient perfusion of most of the heart. Arteriosclerotic occlusion of the

LMCA is equivalent to occlusion of the anterior interventricular and circumflex branches, may reduce the coronary flow to a large proportion of the ventricular myocardium, whose territories will suffer the consequences of ischemia to a greater or lesser extent according to the degree of intercoronary collateral circulation. Segments of arteries subjected to systolic kinking are known to be particularly liable to intimal changes and atherosclerosis.^{3,4} Lewis et al.⁵ suggested that in the presence of a short main left coronary artery trunk, the initial part of the left anterior descending artery is exposed to unusual stress from systolic kinking, with resulting impairment of the blood supply to the bundle of His. Knowledge of the morphological characteristics of

the LMCA as well as its variations is essential for hemodynamic and surgical manipulation as well as for correctly interpreting angiographic data.⁶ The LMCA and its branches have been described in other populations by classical dissection, injection-corrosion and radiographic techniques, some having a clinical orientation and others taking up a basic position. In the absence of a North Indian population study, this work was aimed at determining the different morphological characteristic of the LMCA and its branches on angiography, characterizing these variations and their associations with gender, dominance and CAD.

MATERIALS AND METHODS

The study was conducted on patients who underwent coronary angiography for suspected coronary artery disease or for coronary intervention during the period June 2014 to June 2015 at a tertiary care centre in North India. The angiography was done on Artis zee floor – mounted system by Siemens Healthcare. Angiographic images were viewed in cine mode in standard views. Origin and length of left main coronary artery was noted and categorized as Long i.e. >15 mm, Short i.e. ≤5 mm and Normal i.e. >5 & ≤15 mm. The length of the left main coronary artery was measured from its point of origin to its division. Dominance was noted on the basis of the origin of posterior descending artery. Patients were categorized as having significant CAD if they had more than 50% narrowing of intraluminal diameter. The data was analyzed by Epi Info software. The association of length and divisions of LMCA with gender, dominance and CAD was analyzed by calculation using odds ratio. Chi-square test (χ^2) was also done and association considered significant for p value <0.05.

RESULTS

The study was done on 1130 patients with male patients being 803 (71.1%). The mean age of patients was 57.37 ± 10.60 years (Range 22-92 years).

LMCA was not observed in 8 (0.7%) cases as both LAD and LCX arteries have an independent opening in the left aortic sinus or there was ectopic origin of the LCX artery. Of these cases LMCA was not found in 6 (0.53%) males and in 2 (0.18%) females. In one case LMCA was continuation of single coronary artery arising from the left aortic sinus. These 9 cases were excluded from the study. In all of the remaining 1121 cases LMCA takes origin from left aortic sinus. Also, 6 more cases were excluded due to CAD of LMCA or where LMCA was not cannulated. The dominance was right in 75.43%, left in 12.11% and co-dominant in 12.47% cases. The prevalence of length of LMCA and its divisions is shown in Table-1 and Table-2 respectively.

LMCA length was found to be within normal limits (Fig. 1) in 831 (74.53%) cases out of which 604 (72.68%) cases are male and 227 (27.32%) cases are female. In 183 (16.41%) cases length of LMCA was found to be long (Fig. 2) out of which 124(67.76%) cases are male and 59 (32.24%) cases are female. In 101 (9.06%) cases short LMCA was observed (Fig. 3) out of which 64 (63.37%) were male and 37 (36.63%) female.

Division of LMCA into two branches i.e. LAD and LCX coronary arteries (Fig. 2 & 3) was found in 942 (84%) cases out of which 655 (69.5%) are male and 287 (30.5%) female. In 179 (16%) cases trifurcation of LMCA was observed (Fig. 1) as one other coronary artery namely ramus or intermediate also takes origin from LMCA. Out of these cases of trifurcation of LMCA 142 (79.3%) are male and 37 (20.7%) female.

Increased prevalence of long LMCA was observed in right dominance and this association was found statistically significant ($\chi^2=13.04, df=2, p=0.0015$). No association was observed between length of LMCA and trifurcation of LMCA. Also, increased prevalence of trifurcation of LMCA was observed in males (OR 1.69, 95% CI 1.15-2.49) and this association was found significant ($\chi^2=7.14, df=1, p=0.008$).

CAD was observed in 664 (59.55%) cases out of which 544 (81.93%) cases were male. No

association between length or branches of LMCA and CAD was observed.

Table-1 Genderwise distribution of length of LMCA

| Length | Total | Male | Female |
|-------------|-----------------|-----------------|-----------------|
| Normal LMCA | 831 (74.53%) | 604 (76.26%) | 227 (70.28%) |
| Long LMCA | 183 (16.41%) | 124 (15.66%) | 59 (18.27%) |
| Short LMCA | 101 (9.06%) | 64 (8.08%) | 37 (11.45%) |
| Total Cases | 1115 | 792 | 323 |

Table-2 Genderwise distribution of division of LMCA

| | Total | Male | Female |
|--------------|--------------|--------------|--------------|
| Bifurcation | 936 (84%) | 650 (82%) | 286 (89%) |
| Trifurcation | 179 (16%) | 142 (18%) | 37 (11%) |
| Total | 1115 | 792 | 323 |

Table 3 Prevalence of trifurcation of LMCA.

| Author | Year | No. of Cases | Trifurcation of LAD (%) |
|---------------------------------|------|--------------|-------------------------|
| Baptista et al ¹⁷ | 1991 | 150 | 38.7 |
| Cavalcanti et al ¹⁹ | 1995 | 110 | 38.18 |
| Kalpana et al ¹⁹ | 2003 | 100 | 40.0 |
| Cademartiriet al ²⁰ | 2007 | 202 | 17.0 |
| Kosar et al ²¹ | 2009 | 700 | 31.0 |
| Bazzocchi et al ²² | 2011 | 3,236 | 21.3 |
| Udhayakumar et al ²³ | 2012 | - | 22.5 |
| Agnihotri et al ²⁴ | 2013 | 100 | 30.0 |
| Ogengo et al ²⁵ | 2014 | 208 | 32.2 |
| Current Study | 2015 | 1115 | 16.0 |

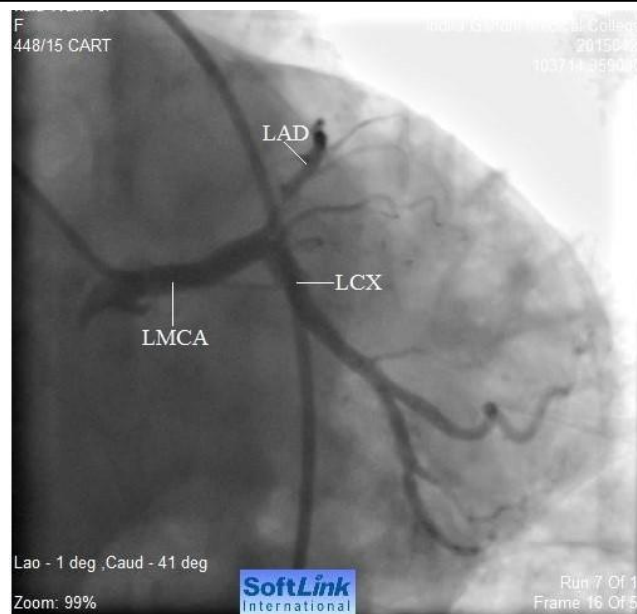


Fig. 2 Coronary angiogram of a female patient in left anterior oblique (caudal) view showing long LMCA dividing into LAD & LCX. Also note the atherosclerosis in the LAD.

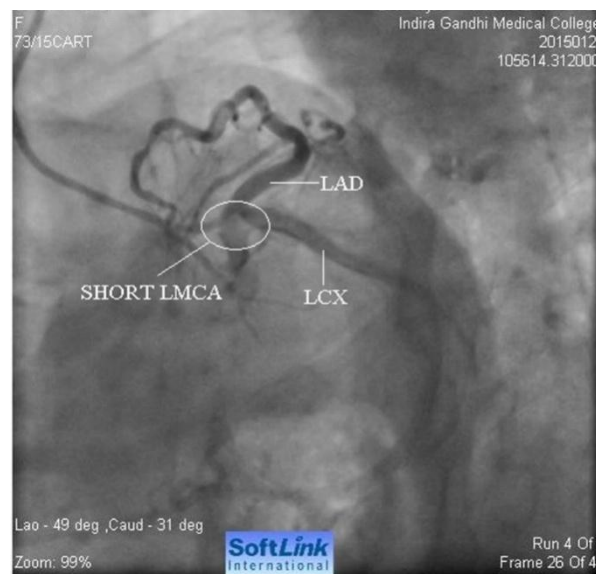


Fig. 3 Coronary angiogram of a female patient in left anterior oblique (caudal) view showing short LMCA dividing into LAD & LCX.

DISCUSSION

The LMCA is generally considered to be between 5–15 mm long, although data published by several authors show a certain degree of disparity in results, depending on the technique used.⁶ Localization of atherosclerotic changes in the initial part (or 'neck') of the left anterior descending artery has also been attributed to bending or kinking which are believed to enhance

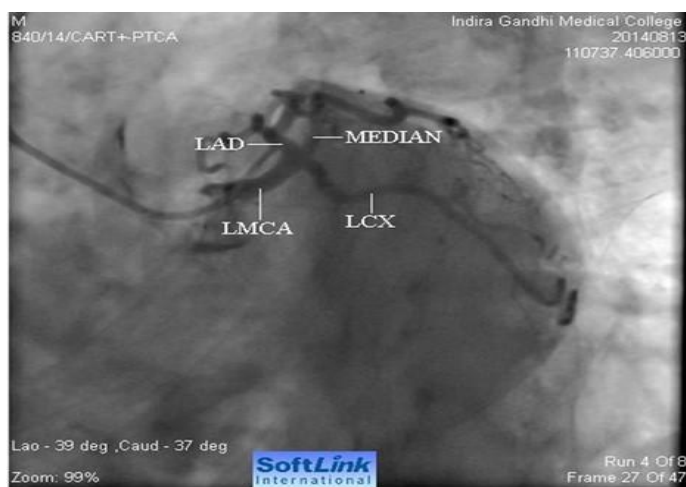


Fig. 1 Coronary angiogram of a male patient in left anterior oblique (caudal) view depicting normal length LMCA dividing into LAD, LCX and median branches

the development of atherosclerosis^{3,4} and longer the main left coronary artery the shorter the 'neck' of the left anterior descending artery and vice versa. A long main left coronary artery indirectly protects the initial part of the left anterior descending artery from atherosclerosis by reducing its loose pliable part and consequently its ability to bend during systole.⁷ Long LMCA is observed in 16.61% cases which is comparable to the observation found in previous studies in which a long common trunk is present in between 11.5% and 18% cases.⁸⁻¹⁰ The short common trunk is observed in 9.02% cases in our study which is comparable to the various studies done by different authors who found its frequency to be between 7% and 12%.^{9,10} The short common trunk may be clinically relevant, especially when a perioperative coronary perfusion or a coronary angiography is performed, because an incomplete image of the area of distribution of the left coronary artery may be seen on introducing the catheter into only one of the terminal branches, and the other does not then show opacification.¹¹ Lewis et al⁵ reported the existence of a short common trunk as a cause of blockage in the left branch of the bundle of His. Gazetopoulos et al⁷ studied the relation between the length of the main coronary artery and the degree of atherosclerosis in its branches by post-mortem examination and suggested that in cases with a short LMCA, the atherosclerotic lesions in the LAD and LCX branches appeared earlier, progressed faster at higher levels of severity and led more frequently to myocardial infarction than in cases with a long LMCA. We could not establish significant correlation with other variables like sex, age and presence or absence of coronary artery disease. We observed significant correlation between the length of LMCA and dominance of heart. i.e. patients with right dominant circulation usually have long LMCA. Kronzon¹² reported a significantly shorter LMCA in subjects with left dominant coronary circulation in his study on 100 patients. This difference may be due to the small number of patients studied by Kronzon or may be due to racial or geographical reasons.

A median artery is one which: 1) originates in the vertex of the angle formed by the main terminal arteries of the left coronary artery, or in the first millimeters, 2) possesses a substantial caliber and 3) has an area of distribution extending half way down the free wall of the left ventricle.^{1,13} Trifurcation of LMCA occurs due to the disturbances in usual regression of vascular sprouts from the network of vessels in the interventricular and atrioventricular grooves during early development.¹⁴⁻¹⁶

The division of the common trunk into anterior interventricular artery, circumflex, and median or intermediate artery is a variation found in between 17% and 40% of cases (Table 3). But in our study we found trifurcation of LMCA only in 16% cases. This may be due to the difference in the methodology and the number of cases as most of the studies were done in few cases on cadavers or may be due to regional or genetic differences.

Recognition of this variant branching pattern is important because it may cause technical difficulties during coronary catheterization and stenting; and because of its potential to supply a significant territory of the myocardium, it constitutes an important source of collateral circulation in case of occlusion of LAD or LCX. Occlusion of median artery in atherosclerosis may be as dangerous as that of the LAD or LCX.²⁵

CONCLUSION

The anatomical variations in the coronary arteries have been suggested as aetiological factors in the pathogenesis of atherosclerosis but we were not able to find out this association. Division of LMCA is independent of length of LMCA. There is increased prevalence of long LMCA in right dominant coronary circulation. Trifurcation of LMCA is more prevalent in males.

Conflict of Interest: All authors have none to declare.

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