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A morphometric anatomical study on the division of the left main coronary artery and myocardial bridges

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SUMMARY

The division of the left main coronary artery (LMCA) exhibits a range of anatomical variation. It can divide into two, three, four or five branches, and have myocardial bridges. This carries important significance in clinical practice. The objective of this study was to examine the morphometric anatomical variation of the LMCA in Vietnamese cadavers. Hearts from 125 cadavers preserved in formalin solution were used in the study. LMCA was present in 96% of the specimens with the mean diameter of 4.62 ± 0.74 mm and the mean length of 9.05 ± 3.61 mm. The LMCA gave rise to two branches (bifurcation) in 51.2%, three branches (trifurcation) in 43.2% and four branches (quadrifurcation) in 5.6%. The mean outer diameter of the anterior interventricular artery, circumflex artery and the intermediate branch were 3.78 ± 0.54 mm, 3.33 ± 0.67 mm, and 1.80 ± 0.62 mm, respectively. The anterior interventricular artery ended at the anterior interventricular sulcus in 1.6% of the specimens, ended at the apex in 21.6%, and crossed over the apex to reach the posterior interventricular sulcus and terminate there in 76.8%. The circumflex artery ended before the left border in 4.13%, at the left border in 46.28%, between the left border and the crux in 46.62% and at the crux in 4.13%. The myocardial bridge was present only at anterior interventricular artery in 41.6%; in both anterior interventricular artery and posterior interventricular branch in 5.6%. LMCA varies in length and it can divide into two, three or four branches. End position of the anterior interventricular artery and the circumflex artery are variable. These variations may prove challenging during percutaneous coronary intervention (PCI) or coronary artery diagnostic imaging.

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Key words: Left main coronary artery – Circumflex artery – Anterior interventricular artery – Intermediate branch – Crux

Abbreviations:

Acute Coronary Syndrome (ACS)
Cardiovascular Disease (CVD)
Coronary Artery Disease (CAD)
Intermediate Branch/Branches (IMB; IMBs)
Left Anterior Descending (Left Anterior Interventricular) Artery (LAD)
Left Circumflex Artery (LCX)
Left Main Coronary Artery (LMCA
Obtuse marginal branches (OM)
Percutaneous Coronary Intervention (PCI)
Posterior interventricular artery (PIV)
Right Coronary Artery (RCA)
Standard Deviation (SD)

INTRODUCTON

In the anatomically normal heart, oxygenated blood is supplied by two coronary arteries and their branches located between the visceral epicardium and myocardium. These arteries originate as two branches from the ascending aorta, and are referred to as the right coronary artery (RCA) and the left coronary artery (LCA). The RCA begins at the anterior/right aortic sinus and passes along the coronary sulcus. Along its course, it gives rise to a sinoatrial nodal artery, conus branch, right ventricular marginal branch, and usually the posterior interventricular (PIV) artery (Loukas,

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2015). It supplies the right atrium, right ventricle, atrioventricular septum and a part of the left ventricle. In contrast, the left main coronary artery (LMCA) originates at the left posterior aortic sinus; runs towards left, under the left auricle; and after a short course, it divides into two, three or four vessels (or bifurcation, trifurcation, or quadrifurcation, respectively) (Moore et al. 2014; Filipoiu, 2014; Kalpana, 2003). These vessels are the left anterior descending (LAD, or left anterior interventricular) artery, the left circumflex artery (LCX), and median or intermediate branch (IMB). The LCX curves to the left around the heart within the coronary sulcus, giving rise to one or more left marginal arteries (also called obtuse marginal branches (OM)) as it curves toward the posterior surface of the heart. The LCX artery ends at the point where it joins to form to the PIV artery in 10-15% of all cases, which lies in the posterior interventricular sulcus (Moore et al., 2014; Fazliogullari et al., 2010). In 67-75% of all cases the PIV artery comes out of the RCA, and in other cases, or 15-18% there is codominance in which branches of the both the LCA and RCA reach the crux of the heart and give rise to the PIV artery (Moore et al., 2014; Fazliogullar, et al., 2010).

A myocardial bridge occurs when one of the coronary arteries tunnels through the myocardium rather than resting on top of it. Thus, as the heart squeezes to pump blood, the muscle exerts pressure across the bridge and constricts the artery. This defect is present from birth, and it can lead to uncomfortable, powerful heartbeats and angina. The incidence of myocardial bridging differs based on the mode of evaluation (Lee and Chen, 2015). This condition in the general population has been estimated at 5% based on autopsy findings (Pelliccia, 2009). In other studies, the frequency of myocardial bridging was found to vary between 1.5 - 16%, when determined by coronary angiography, and to be as high as 80% when observed during autopsy (Alegria et al., 2005; Hwang et al., 2010). Even so, the significance of myocardial bridging when found in association with other cardiac conditions is unknown (Lee and Chen, 2015; Ragosta M, 2010).

In addition to myocardial bridging, the LCA exhibits a dynamic anatomical variation with respect to origin, length and number of terminal branches (Roy et al. 2014; Ballesteros and Ramirez, 2008; Bhimalli, et al., 2011). Further, studies suggest that measurements of coronary artery length done via angiography are less accurate than those done on post-mortem specimens due to underestimation secondary to the effects of rotation, angulation and foreshortening (Roy et al., 2014; Nguyen et al., 2013; Wilson et al., 1967).

Cardiovascular disease (CVD) is a group of diseases that include the heart and blood vessels, thereby including coronary artery disease (CAD), and acute coronary syndrome (ACS) (Sanchis- Gomar et al., 2016). Healthcare professionals frequently use these terms interchangeably, but they are not the same. ACS is a subcategory of CAD, and is usually presented in patients by a range of signs and symptoms such as unstable angina due to decreased blood flow in the coronary arteries such that part of the heart muscle is unable to function properly or dies (Amsterdam et al., 2014; Lippi et al., 2016; Sanchis-Gomar et al., 2016). CAD is characterized by atherosclerosis in coronary arteries and can be asymptomatic, and is usually used to refer to the pathologic process affecting the coronary arteries (usually atherosclerosis); with ACS including the diagnoses of angina pectoris, myocardial infarction and silent myocardial ischemia (Sanchis- Gomar et al., 2016; Cervellini et al., 2014). Congestive heart disease mortality results from CAD.

CAD is the most common type of heart disease, and is the leading cause of death in the United States in both men and women (Medline Plus, 2017), and is a major cause of death and disability in developed countries (Roger, 2007). In fact, 15.5 million individuals of age equal to-or-greater than 20-years in the United States are affected (Mozaffarian et al., 2016). Even further, there is a correlation between the length of the LMCA and the atherosclerosis present in its branches or the presence of a complete left bundle branch block (Gazetopoulos et al., 1976; Roy et al., 2014; Nguyen et al., 2013). The United States and westernized cultures are not alone in these trends, which are now being observed in India, Turkey and other Third-World Countries including Vietnam (Sanchis-Gomar et al., 2016; Anbumani et al., 2016; Priyadharshini et al., 2016; Nguyen et al., 2012, 2014; Dang et al., 2011; VNHA, 2017). In Vietnam, stroke is the leading cause of death followed by heart disease, and mortality from CAD is rapidly increasing (Nguyen et al., 2012, 2014; Dang et al., 2011; VNHA, 2017). According to the Vietnam National Heart Association, 20% of the Vietnamese population suffers from CVD (VHNA, 2017), and 16.3% of North Vietnamese suffer from CAD (VHNA, 2017; Dang, 2016). Increased physical inactivity, obesity, nicotine abuse, bad nutrition practices and loss of traditional diet habits in new-industrial cultures, as well as social inequalities, are suggested as factors leading to an increase of prevalence in most countries (Sanchis-Gomar et al., 2016).

The variation in the division of the LMCA carries important significance in diagnosis, management and treatment of CAD. Yet, there are no published studies that describe these variants in the Vietnamese population. The present research was conducted to address this gap in knowledge, by examining the anatomy of the LMCA and its branches in Vietnamese cadaveric specimens, and comparing the present findings to data in published literature.

MATERIALS AND METHODS

Anatomical Donors and Preservation

This study was conducted on the hearts of 125 Vietnamese cadavers including 91 males and 34

Table 1. Diameter and length of the LMCA.

No. of Specimens	Diameter of the LMCA		
	Mean (mm)	Smallest (mm)	Largest (mm)
125	4.62 ± 0.74	3.32	8.74
No. of Specimens	**Length of the LMCA**		
	Mean (mm)	**Smallest (mm)**	**Largest (mm)**
125	9.05 ± 3.61	2.35	19.21

Table 2. Division of the LMCA.

No. of Specimens	The number of branches from LMCA			
	2 branches (0 intermediate branch)	*3 branches (1 intermediate branch)*	*4 branches (2 intermediate branches)*	*5 branches (3 intermediate branches)*
125	50.4%	44%	5.6%	0

females. These anatomical donors had been prepared for use in the formal course in human gross anatomy in the Department of Anatomy at the University of Medicine and Pharmacy at Ho Chi Minh City, Vietnam, from years 2011 to 2014. The age range of subjects in this cohort was 33 to 95 years with the average age of 68.1-years-old. Hearts were excluded from this cohort if the subject had previous heart disease or percutaneous coronary intervention (PCI). All guidelines were followed regarding the use and care of cadaveric materials, as well as all regulations set forth by the Vietnamese Anatomical Education Program.

The embalming procedure is a 2-phase procedure beginning within the first 24 hours after death. The first step of the first phase of the embalming procedure is an injection of a 18 L mixture composed of 37% Formalin (2 L); 1 M Phenol (1 L); Glycerin 1 L, 90% Alcohol (2 L) and water (12 L). Three days following injection, cadavers are placed into 300 L of solution composed of 37% Formalin (2 L); 1 M Phenol (3 L) and water (295 L). The specimens remain submerged in the vat for a minimum of 4 months.

Measurements

Using a caliper with a center distance attachment, measurements of the left coronary system were taken, and the data were saved and evaluated using MicroSoft® Excel 2007. The following data were recorded: (1) size (length and diameter) of the LMCA; (2) division of the LMCA; (3) size of the branches of the LMCA, and (4) termination point of the LCX and LAD. The length of myocardial bridges was also measured. In cases where vessels were curled, vessel length was measured by using a thread placed on the vessel running along its length, and then the thread was straightened and its length measured. Results were expressed as mean length (or diameter) in millimeters (mm) ± mm standard deviation (SD).

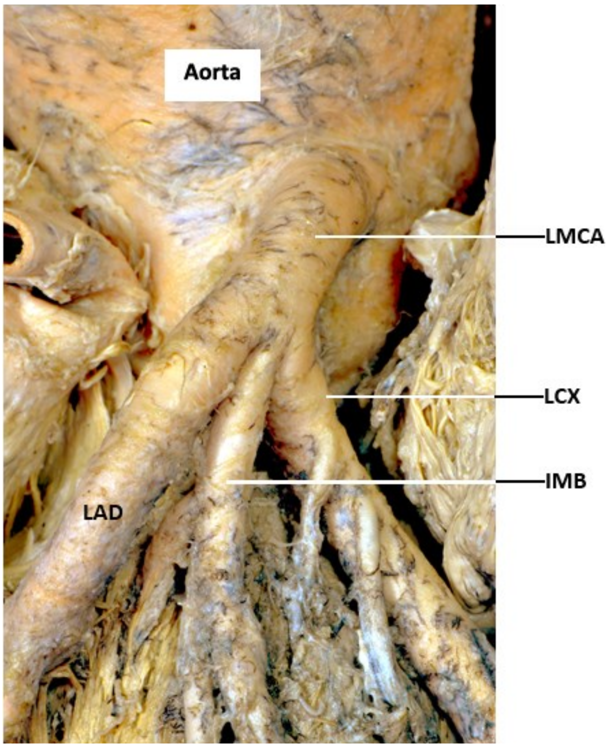

Fig 1. Intermediate Branches of the LMCA. This cadaveric specimen is representative of a single intermediate branch (IMB) arising from the division of the LMCA. [Abbreviations: Left Main Coronary Artery (LMCA); Left Anterior Descending (LAD); Left Circumflex Artery (LCX); Intermediate Branch (IMB)]

Photography

Digital photography of the external features of the left coronary circulation was done using a NIKON D3100 SLR Camera (B&H Foto & Electronic Corporation, NY) equipped with an 18-55 mm VR NIKKOR Macro lens and a Nikon 40 mm f/2.8G AF-S DX NIKKOR 2200 VR Micro lens.

RESULTS

Size of the LMCA

Of the 125 hearts examined in this study, one had no LMCA. In this single case, the LAD and the LCX arose directly from the left posterior aortic sinus. Four hearts had an artery that arose from the left posterior aortic sinus but only give rise to the LAD. These four cases were considered as the LAD originating directly from the left posterior aortic sinus with no LMCA or LCX. The remaining 120 specimens had a LMCA. The mean diameter of the LMCA was determined to be 4.62 ± 0.74 mm; 3.32 mm (smallest) and 8.74 mm (largest). The length of the LMCA was determined to be 9.05 ± 3.61 mm SD; 2.35 mm (shortest) and 19.21 mm (longest). These data are shown in Table 1.

Division of the LMCA

Commonly, the LMCA bifurcates into the LAD and the LCX. However, there are cases in which the LMCA divides into three, four or five branches.

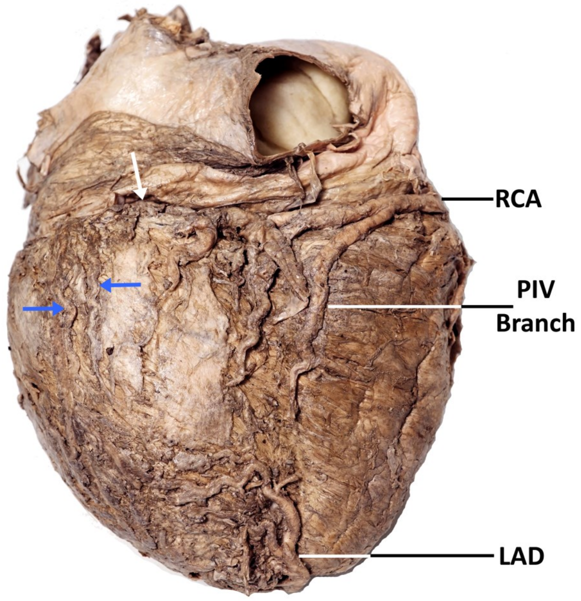

Fig 2. Termination of the LAD. In this inferior aspect of the heart, the LAD terminates at the posterior interventricular sulcus. [Abbreviations: Left Anterior Descending (LAD); Right Coronary Artery (RCA); Posterior Interventricular (PIV); Left Circumflex Artery (white arrow) and branches (blue arrows)]

Aside from the LAD and LCX, these branches are called intermediate branches (IMBs). The present work documents 50.4% (2 branches and no IMB), 44% (3 branches with 1 IMB), 5.6% (4 branches with 2 IMBs, respectively (Fig. 1 and Table 2). None of the 125 hearts examined showed 5 branches with 3 IMBs).

Diameter of Left Coronary Artery System Vessels at Their Origin

To further characterize the architecture of the left coronary arterial system in Vietnamese hearts, the outer diameter of the LAD, LCX and IMBs were measured at their origins from the LMCA (Table 3). For the LAD, the mean for the outer diameter was determined to be 3.78 ± 0.54 mm; 2.81 mm (smallest) and 6.32 mm (largest). In examining the LCX, the mean outer diameter was calculated to be 3.33 ± 0.67 mm; 1.61 mm (smallest) and 5.07 mm (largest). The outer diameter of IMBs ranged from 0.78 mm (smallest) to 3.46 (largest) with a mean diameter of 1.82 ± 0.59 mm.

Termination Point of the LAD

The LAD lies in the anterior interventricular sulcus and descends to the notch of the cardiac apex. It can terminate before reaching the cardiac apex, at the cardiac apex or it can reach as far as the posterior interventricular sulcus. In this investigation, only 2 cases (1.6%) had LAD that terminated before reaching the cardiac apex. There were 27 specimens (21.6%), where the LAD terminated at the cardiac apex. In addition, the LAD passed the cardiac apex to reach into the posterior interventricular sulcus in 96 cases (76.8%) (Fig. 2).

Table 3. Origin diameter of vessels arising from the LMCA

Diameter of LAD			
No. of Specimens	**Mean (mm)**	**Smallest (mm)**	**Largest (mm)**
125	3.78 ± 0.54	2.81	6.32
Diameter of LCX			
No. of Specimens	**Mean (mm)**	**Smallest (mm)**	**Largest (mm)**
125	3.33 ± 0.67	1.61	5.07
Diameter of Intermediate Branch			
No. of Specimens	**Mean (mm)**	**Smallest (mm)**	**Largest (mm)**
125	1.82 ± 0.59	0.78	3.46

Table 4. Variation in the termination point of the LCX

No. of Specimens	**Termination point of LCX**				
	Before reaching the left border of the heart	At the left border of the heart	Between the left border of the heart and the crux	At the crux	After the crux
125	4.13%	46.28%	45.46%	4.13%	0

Termination Point of the LCX

The LCX follows the left coronary sulcus to the left side of the heart and courses down to the diaphragmatic side of the left ventricle, reaching the intersection point of the coronary sulcus and posterior interventricular sulcus. This point of intersection can be termed the “crux”. The termination point of the LCX has a significant anatomic variation, but corresponds closely to the blood supply of the heart. Termination can be: (1) before reaching the left border of the heart; (2) at the left border of the heart; (3) between the left border of the heart and the crux; (4) at the crux; or (5) after the crux. In this study, the percent of the 125 specimens examined with terminations of the LCX at these points was determined to be: 4.13%, 46.28%, 45.46%, 4.13%, and 0%, respectively (Table 4).

Myocardial Bridges

The overall incidence of myocardial bridges in this study is 48.8%, or 61 specimens of the 125 hearts that were examined (Fig. 3). This occurred only in the LAD in 52 specimens (41.6%); only at the PIV branch in 2 specimens (1.6%), and was present in both the LAD and PIV in 7 specimens (5.6%). With respect to the LAD, the mean length was determined to be 20.98 ± 11.28 mm (minimum length: 6.24 mm; maximum length: 66.45 mm. For the PIV, the mean length was 19.26 ± 9.28 mm (minimum length: 3 mm; maximum length: 33.3 mm). The depth of myocardial bridges was not measured in this study.

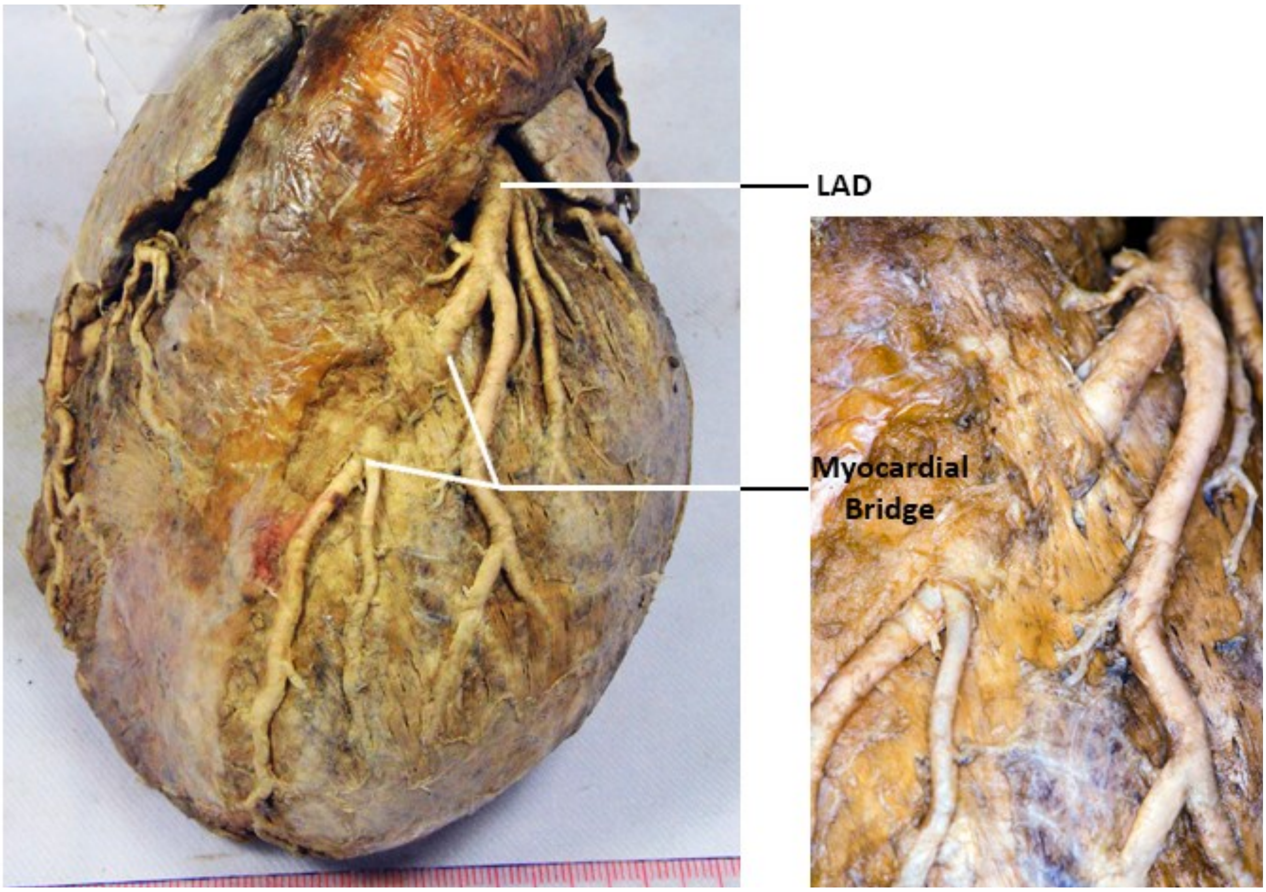

Fig 3. Myocardial Bridge. In this photograph of the dissection of the left coronary vascular system a myocardial bridge is demonstrated (left). This same myocardial bridge is seen in the enlarged view (right).

DISCUSSION

Increasingly, diagnostic and interventional procedures such as coronary angiography; MRI and 3-dimensional computed tomography; angioplasty and stent placement, are done to assess, diagnose and treat CAD (Fazliogullari et al., 2010; Hamdan et al., 2011; Roy et al., 2014; Anbumani et al., 2016; Nguyen et al., 2012). For a successful coronary angiogram, correct interpretation of other diagnostic tests, and for therapeutic and/or interventional or surgical procedures to have positive outcomes, a thorough knowledge of the normal architecture and anatomical variants of the coronary arterial system is essential. This investigation addressed this issue by examining the anatomy of the left coronary vasculature in Vietnamese cadavers.

In dissecting 125 hearts, it was discovered that one had no LMCA. In this case, the LCX and the LAD arose directly from the left posterior aortic sinus. Four had an artery that arose from the left posterior aortic sinus but only give rise to the LAD. For the purposes of this study, it was decided to consider these cases as the LAD arose directly from the left posterior aortic sinus with no LMCA or LCX. The remaining 120 specimens had a LMCA for which the diameter and length (Table 1) were measured to be 4.62 ± 0.74 mm and 9.05 ± 3.61 mm, respectively. These data are reasonable when compared to the results of studies done in other geographic and ethnic groups (Fig. 4 and Fig. 5) (Anbumani et al., 2016; Bhimalli et al., 2011; Gazetopoulos et al., 1976a, b; Kalpana, 2003; Ortale et al., 2005; Reig and Petit, 2004; Roy et al., 2014). Filipoiu (2014) defined the length of the LMCA less than 5 mm to be short and more than 5 mm to be long. In another study, the length of the LMCA less than 5 mm is considered short; from 6 mm to 15 mm is defined as intermediate length, and more than 15 mm is termed long (Ballesteros and Ramirez, 2008). It has been suggested that there is a relationship between the length of the LMCA and atherosclerosis. Prior studies have shown that patients that have a shorter LMCA also have a higher incidence, and earlier presentation, of atherosclerosis in contrast to those patients with a longer LMCA (Gazetopoulos et al., 1976a, b; Saltissi et al., 1979; Ajayi et al., 2013; Roy et al., 2014). The reason for this is not clear. However, one hypothesis is that the atherosclerotic process may be related to changes in fluid velocity, bubble collapse and micro jets within the vascular pathway that result in endothelial cavitation (Nguyen and Talarico, 2018; Nguyen and Daaboul, 2018).

Bifurcation of the LMCA into the LAD and LCX is a common branching pattern, and this was also

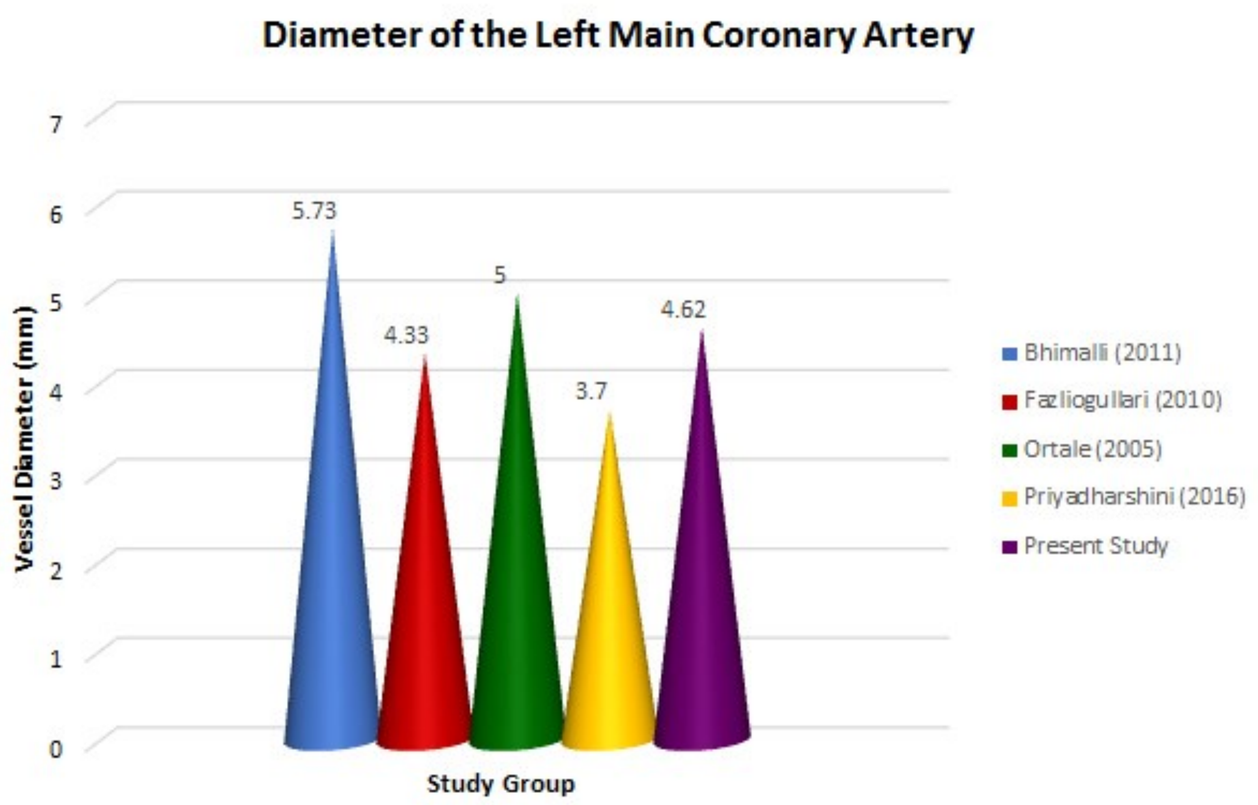

Fig 4. Diameter of the Left Main Coronary Artery. This diagram is a graphical comparison of the mean diameter of the left main coronary artery found in Vietnamese cadaveric specimens (purple) in the current investigation with the results of other studies.

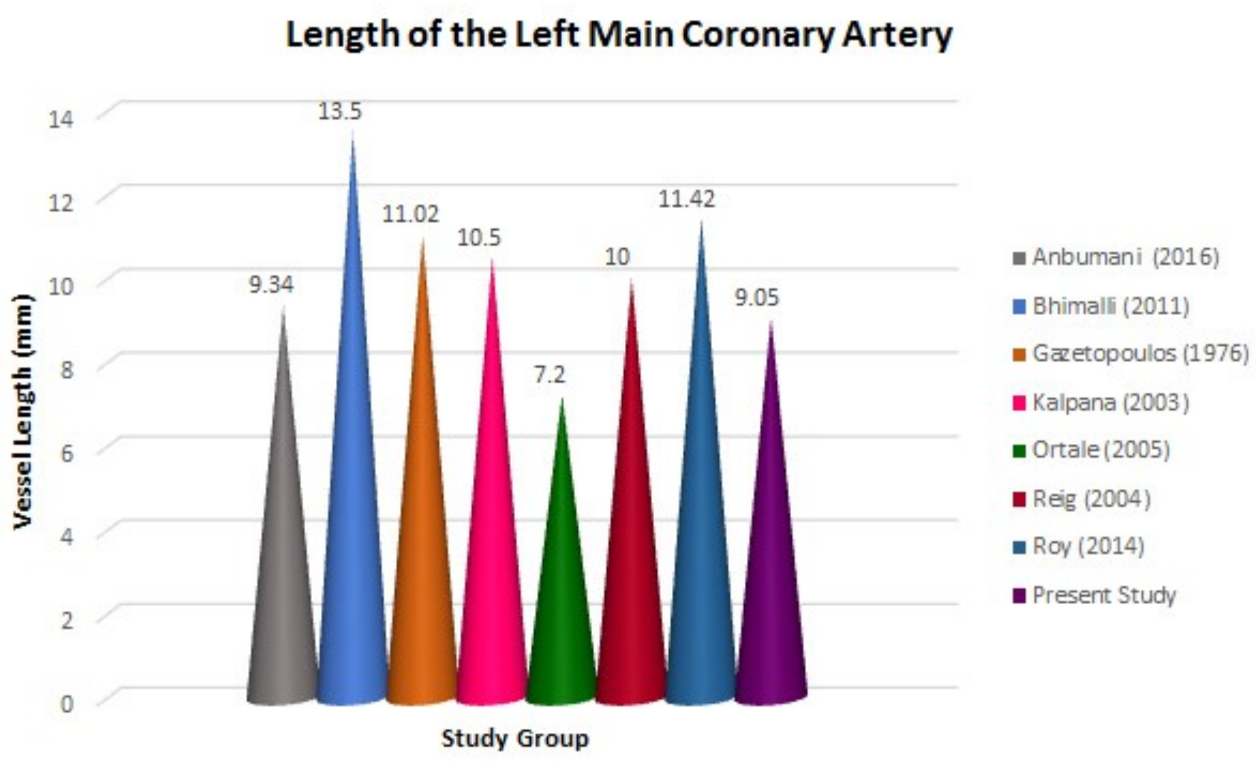

Fig 5. Length of the Left Main Coronary Artery. The mean of the length of the left main coronary artery in this study (purple) is within the range of results from other research studies in cadaveric specimens of different ethnic backgrounds and geographic origins.

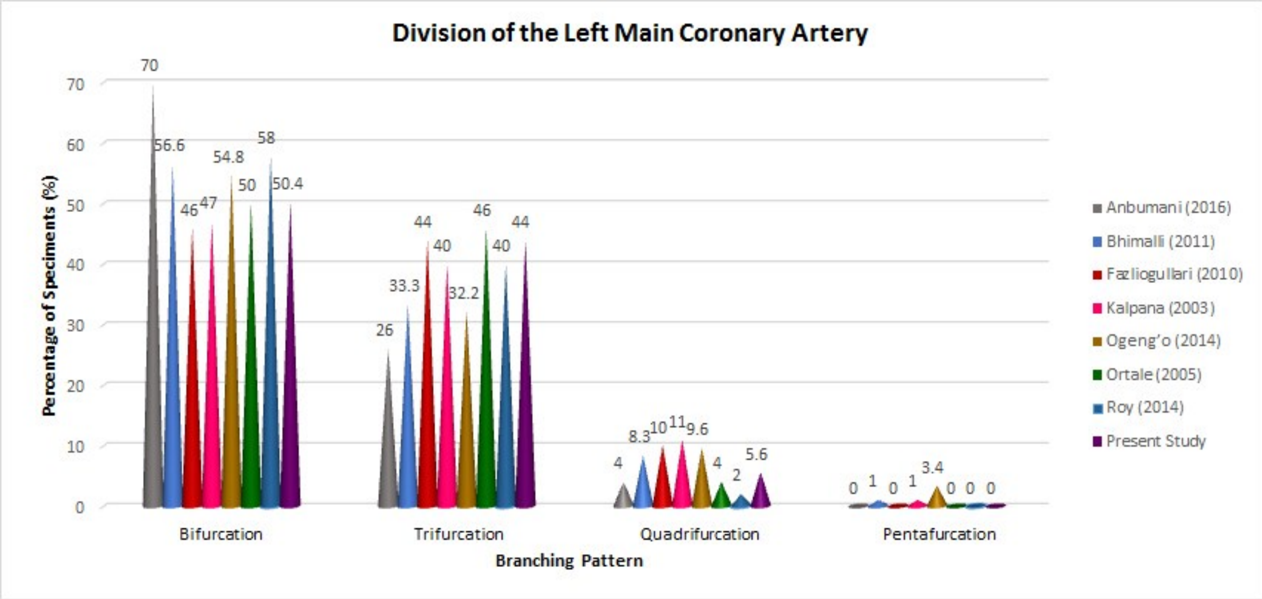

Fig 6. Division of the Left Main Coronary Artery. The left main coronary artery typically divides into the left anterior descending (LAD) and left circumflex (LCX) arteries (i.e., two branches or bifurcation). Anatomical variation can result in additional branching, or the development of intermediate branches (IMB), resulting in trifurcation (i.e., LAD, LCX and a single IMB), quadrifurcation (i.e., LAD, LCX and two IMBs), or pentafurcation (i.e., LAD, LCX and three IMBs). The results in the present study (purple) are compared to the branching patterns revealed by other investigators.

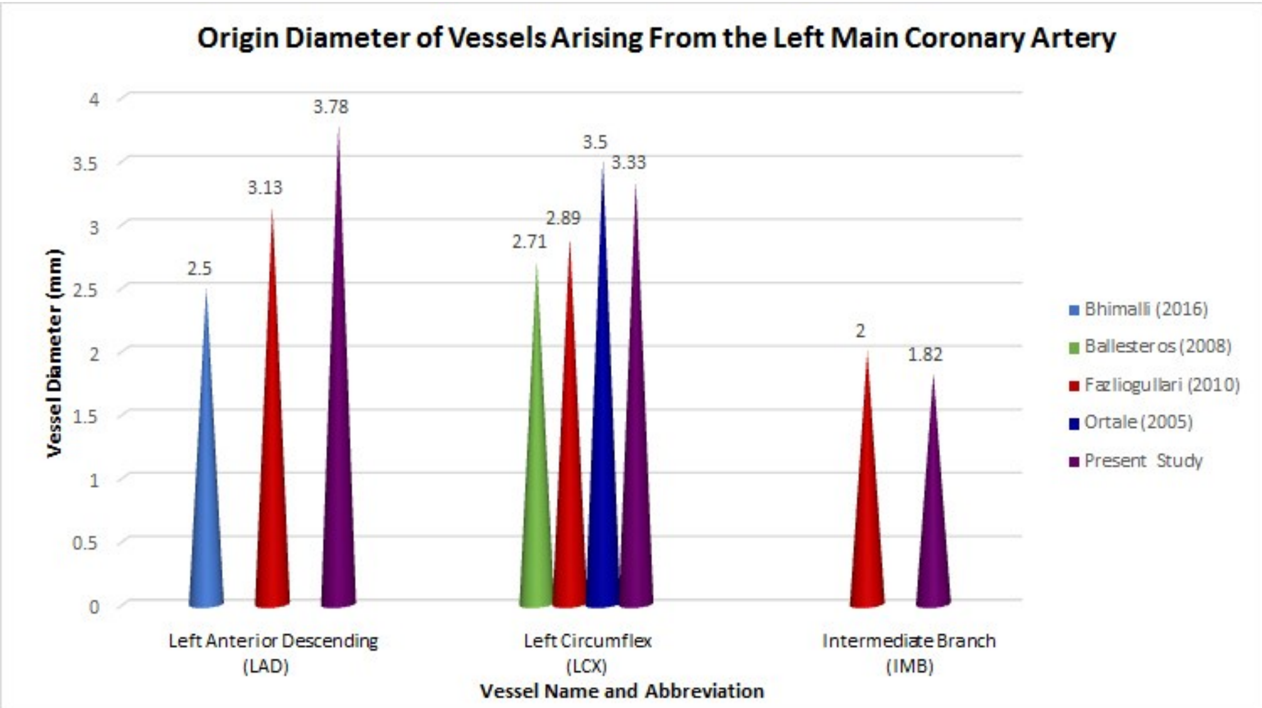

Fig 7. Origin Diameter of Vessels Arising From the Left man Coronary Artery. The left main coronary artery divides into the left anterior descending (LAD) and left circumflex (LCX) arteries, and may give rise to one or more intermediate branches (IMB). The diameter of these vessels at their origin varies. A comparison of the diameters of the LAD, LCX and IMB in this study (purple) are shown here to be similar to those diameters that have been measured in other studies.

observed in the present study in 50.4% of the hearts examined (Table 2). Intermediate branching, or branching in addition to the LAD and LCX, also occurs and can result in trifurcation, quadrifurcation and pentafurcation (Bhimalli et al., 2011; Fazliogullari et al., 2010; Kalpana, 2003; Ogeng'o et al., 2014; Ortale et al., 2005; Reig and Petit, 2004; Roy et al., 2014). In the current study, 49.6% of the specimens had one or more IMBs with a majority (or 44%) had only one IMB (Table 2; Fig. 1). This result is not significantly different from other investigations (Fig. 6) (Bhimalli et al., 2011; Fazliogullari et al., 2010; Kalpana, 2003; Ogeng'o et al., 2014; Ortale et al., 2005; Reig

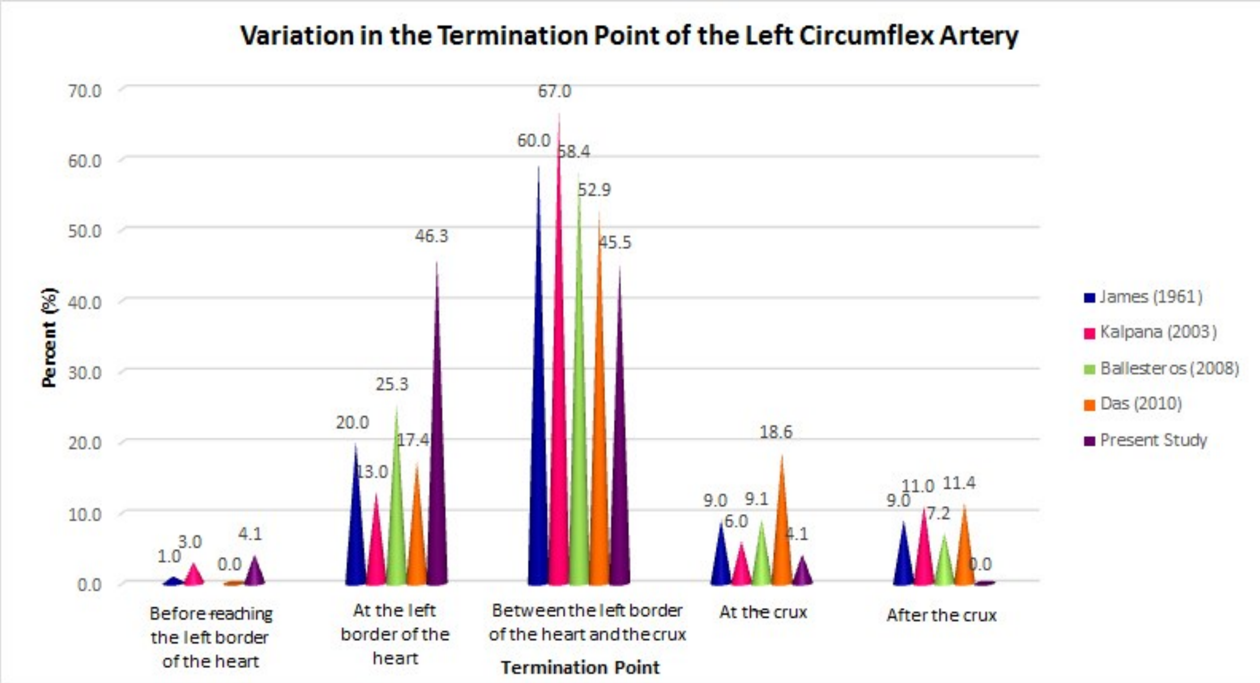

Fig 8. Variation in the Termination Point of the Left Circumflex Artery. There are five known anatomical variants for the terminus of the left circumflex artery (LCX). These are: (1) before reaching the left border of the heart; (2) at the left border of the heart; (3) between the left border of the heart and the crux; (4) at the crux; (5) after the crux. This graphical presentation shows a comparison of these termination points in the present study (i.e., percent of specimens with specific LCX termination points; purple) with those revealed by other investigators.

and Petit; 2004; Roy et al., 2014). However, in the Vietnamese patients studied here, no cases with three IMBs (or pentafurcation) were observed in contrast to those hearts examined in other investigations (Bhimalli et al., 2011; Kalpana, 2003; Ogeng'o et al., 2014). According to Angelini (2007), the presence of an IMB is a variant of coronary artery morphology and it is not a dysmorphic feature with the relevance over 1% in the general population. However, this variation in branching of the coronary artery can prove challenging to the interventional cardiologist; thus stressing the importance of a comprehensive understanding of these anatomical patterns (Ogeng'o et al., 2014).

The outer diameters of the LAD, LCX and IMBs in this study, were found to be 3.78 ± 0.54 mm, 3.33 ± 0.67 mm and 1.82 ± 0.59 mm, respectively. These results for the LCX and LAD diameters are comparable to Ortale's (Ortale et al., 2005) results but larger than Ballesteros', Bhimalli's and Fazliogullari's results (Fig. 7) (Ballesteros and Ramirez, 2008; Bhimalli et al., 2011; Fazliogullari et al., 2010). The study of Fazliogullari et al. (2010) was performed on formalin-reserved cadavers similar to the work presented here. Ballesteros (Ballesteros and Ramirez, 2008), on the other hand, measured the diameter of the arterial lumen, not the outer diameter. Further, the results in this study show no significant difference from Fazliogullari's study (Fazliogullari et al., 2010). Finally, in comparison with the LAD and the LCX, the IMB has smaller diameter.

In this study, the termination of the LAD was prior to reaching the cardiac apex in 2 cases (1.6%), at the cardiac apex in 27 cases (21.6%), and passed the cardiac apex into the posterior interventricular sulcus (Fig. 2) in 96 cases (76.8%). This result showed no significant difference from a prior study in patients from India, where 80% of specimens had LAD that terminated at the posterior interventricular sulcus (Kalpana, 2003). Generally, the terminal portion of the LAD goes over the apex and supplies the blood to the inferior surface of the heart. Therefore, if there is acute occlusion of this LAD artery, then the patient could have ST segment elevation (indicating myocardial ischemia or infarction) in the anterior and inferior leads. Thus, it important for clinicians and anatomists to know about the length of the LAD in Vietnamese patients.

This investigation also examined the termination points of the LCX. The most common termination points of the LCX are the left border of the heart and in between the left border of the heart and the crux. In general, the results of this investigation showed a shorter LCX compared to previous studies (Fig. 8) (James, 1961; Kalpana, 2003; Ballesteros and Ramirez, 2008; Das et al., 2010). Further, none of the Vietnamese specimens in this study had LCX termination past the crux of the heart, a greater number of Vietnamese hearts had terminations at the left border of the heart (46.28%), and fewer between the left border of the heart and the crux (45.46%), in contrast to prior studies (James, 1961; Kalpana, 2003; Ballesteros and Ramirez, 2008; Das et al., 2010). The reason underlining these differences in not clear.

Out of 125 specimens dissected in the present study, myocardial bridges occurred in 48.8%. This is higher than the results of a prior study, where the incidence of myocardial bridges was found to be 34.5% in a total of 200 examined hearts (Loukas et al., 2006). This same study (of cadaveric hearts from Poland) reported an incidence of 17.5% of hearts with myocardial bridges occurring in the LAD, in contrast to the present research showing 47.2% of Vietnamese cadaveric hearts with myocardial bridges in the LAD. Even further, it was found that the presence of bridges appeared to be related to coronary dominance, especially in the left coronary circulation, where 66.6% of the hearts with bridges were left dominant vs. 24.6% that were right dominant (Loukas et al., 2006). Left vs. right dominance, and relationship to myocardial bridging, was not examined in the current work.

The presence of myocardial bridges and their relationship to coronary artery dominance supplying the myocardium may be clinically significant. Myocardial bridges may compress the coronary vessel underneath and compromise myocardial blood supply. Cases of sudden cardiac death where myocardial bridging is the only postmortem finding have been reported (Angelini et al., 1983; Saidi et al., 2010). In addition, there are reports of pathological observations indicating the virtual absence of atheromatous changes in the tunneled coronary segments while affecting the pre-bridged segments of the coronary (Angelini et al., 1983; Saidi et al., 2002, 2010). It is not understood if the bridged vessel is composed of structural elements that make it resilient to hemodynamic stresses imposed by such compression. However, studies suggests that the tunica intima under myocardial bridges is spared from atherosclerosis, and that the thick perivascular space around the bridged segment may protect it from extreme compression (Saidi et al., 2010; Resar et al., 1997).

CONCLUSION

The present study showed that LMCA varies significantly in length in different individuals. Aside from the LAD and the LCX, the LMCA may give rise to another one or more branches called intermediate branches. The LCX often terminates either at the left border of the heart or slightly further. The LAD not only follows along the anterior interventricular sulcus, but also frequently courses along the diaphragmatic side of the heart into the posterior interventricular sulcus. These anatomical variations can cause confusion and difficulties in coronary angiogram and in PCI. Thus, this morphometric study done on left coronary arterial system in Vietnamese cadaveric hearts may be helpful for interventional cardiologists and radiologists in diagnosis and in avoiding vascular trauma during diagnostic and therapeutic procedures. As such, anatomists also need to be cognizant of these variations when instructing student doctors and graduate students in the human gross anatomy laboratory.

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NOTES ON CONTIBUTORS

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