

Third branch derived from left coronary artery: the median artery

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Summary

Our purpose was to describe the number and trajectory of terminal branches of main trunk of left coronary artery in the Turkish cadavers. Our study was conducted on 50 hearts from adult cadavers, and the numbers of branches of main trunk of the left coronary artery were analyzed. We refer to "the median artery" as the artery deriving from the main trunk in addition to two terminal branches originating from the left coronary artery, and "r.lateralis" (r.diagonalis) as branches originating from a.interventricularis anterior. The most frequent type of division of the main trunk of left coronary artery was bifurcation (86%), in 14% of the cases the main trunk of left coronary artery divided into three branches (trifurcation), and a.mediana was detected in 7 hearts. In addition, the diagonal branches derived from a.interventricularis anterior were seen in 49 of the 50 hearts. Sufficient knowledge about the anatomy and variations of coronary arteries is important for proper interpretation of the coronary angiographies and assessment of the findings of coronary insufficiency such as surgical myocardial revascularization. The patient, thus, may have a heart attack in case of an atherosclerotic obstruction of the branches of left coronary artery supplying the majority of blood support of the heart. Distal obstruction of the other branches of a.mediana deriving from the main truncus may have a protective effect against a heart attack.

Key words: Heart, left coronary artery, median artery

Özet

Sol koroner arterden çıkan üçüncü dal: arteriya mediana

Amacımız, Türk kadavralarda, a.coronaria sinistra'nın esas gövdesinden çıkan terminal dalların sayısını ve yönlerini

tanımlamaktır. Bu çalışma erişkin kadavralara ait 50 kalpte yapıldı ve a.coronaria sinistra'nın esas gövdesinin dallarının sayısı analiz edildi. Sol koroner arterden sıklıkla çıkan iki terminal dala ilave olarak kökten çıkan dal a.mediana olarak, a.interventricularis anterior'dan çıkan dallar r.lateralis (r.diagonalis) olarak değerlendirildi. Çalışmamızda, a.coronaria sinistra'nın esas gövdesinin ayrımının en sık tipi bifurkasyon şeklindeydi (%86); vakaların %14'ünde a.coronaria sinistra'nın esas gövdesi üç dala (trifurkasyon) ayrılıyordu ve yedi kalpte a.mediana'ya rastlandı. Ek olarak, 50 kalbin 49'unda a.interventricularis anterior'dan çıkan diagonal dallar görüldü. Koroner arterlerin anatomisi ve varyasyonlarıyla ilgili yeterli bilgi, koroner anjiyografilerin uygun şekilde yorumlanması, cerrahi miyokard revaskülarizasyonu gibi koroner yetersizlik bulgusunun değerlendirilmesi için önemlidir. Bundan dolayı, kalbin büyük bölümünü besleyen sol koroner arterin dallarının aterosklerotik tıkanıklıklarında hasta kalp krizi geçirebilir. Ana trunkustan çıkan a.mediana'nın diğer dallarının distal tıkanıklıkları kalp krizine karşı önleyici bir etkiye sahip olabilir.

Anahtar kelimeler: Kalp, sol koroner arter, median artery

Introduction

Our purpose was to assess the branching of left coronary artery and to describe the trajectory of diagonal branches of main trunk of left coronary artery in the epicardial adipose tissue. Also, it was aimed to study the branches of the main trunk of left coronary artery and to prove importance of the diagonal branch existence in the conditions of coronary insufficiency. In addition, we compared our results with reports performed with different methods previously (1-9).

The right and left coronary arteries issue from the ascending aorta in its anterior and posterior sinuses. The left coronary artery is larger in calibre than the

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Date submitted: July 10, 2007

Accepted: November 13, 2007

right, and supplies a greater volume of myocardium. It lies between the pulmonary trunk and the left auricle. The left coronary artery divides into two or three main rami, its anterior interventricular (descending) ramus being commonly described as its continuation. Anterior interventricular artery ramifies into 2 to 9 large branches. One is often large and may arise separately from the left coronary trunk (which then ends by trifurcation); this left diagonal artery, reported in 33-50% or more cases, is occasionally duplicated (20%) (1). "Intermediate" and "median" refers to the origin but "diagonal" refers to the course of the artery. The terms "intermediate" or "median" should be used for the third branch of the left coronary artery originating between the circumflex branch and anterior interventricular branch.

Coronary anomalies are a poorly understood topic in modern cardiology. Clinicians should be aware of such anomalies, chiefly because such anomalies can result in sudden death (2).

Patency of the left coronary artery is vital for sufficient perfusion of most of the heart. The left coronary artery is responsible for irrigation not only of most of the left ventricle, but also a considerable proportion of the right ventricle (3). The study by Kalbfleisch and Hort irrigated each of the coronary arteries using post-mortem angiography. In arteriosclerotic diseases, it is common that the other main coronary arteries are also affected (4).

Knowledge of the morphological characteristics of the main trunk of the left coronary artery as well as its variations is essential for hemodynamic and surgical manipulation as well as for correctly interpreting angiographic data. Various reports include some details of the morphology of the main trunk of the left coronary artery (length, diameter) but omit other characteristics (type and angle of division) that may be important in clinical and surgical practice (1).

The objective of this study was to analyze the anatomical characteristics of the main trunk of the left coronary artery (length, type of division) in a single series that may be of use in the diagnosis and treatment of its pathologies.

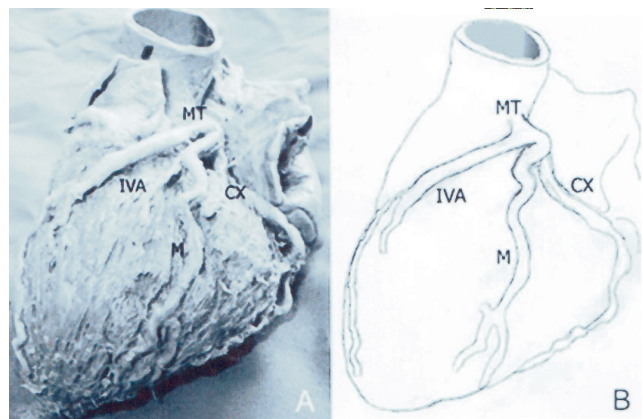
Material and Methods

In this study, 50 adult human cadavers perfused with formaldehyde fixative were used. Cadavers were dissected under 4.0-6.0 magnification with ZEISS dissection microscope, photographed with CANON Power Shot G5. This study was made in the human cadaver heart dissection laboratory in the last 10 years.

The cases with coronary artery disease and cardiomegaly, and pathologically established valvular disease were not included in the study. The ages of the subjects were between 38 to 65 years (33 males and 17 females). The heart was removed after resection of the costosternum and placed in 10% formaldehyde for a period of 5-10 days, depending on the weight of the heart. With gradual separation and retraction of the myocardial fasciculi, the left coronary artery was dissected under 5X magnification. The length of the main trunk of the left coronary artery; the length between the origin of its anterior interventricular (descending) ramus and the origin of the first diagonal branch of the ramus were measured in each specimen using a 0.1 cm sensitive caliper. In addition, we have come upon branching of main trunk of left coronary artery (bifurcation and trifurcation).

Results

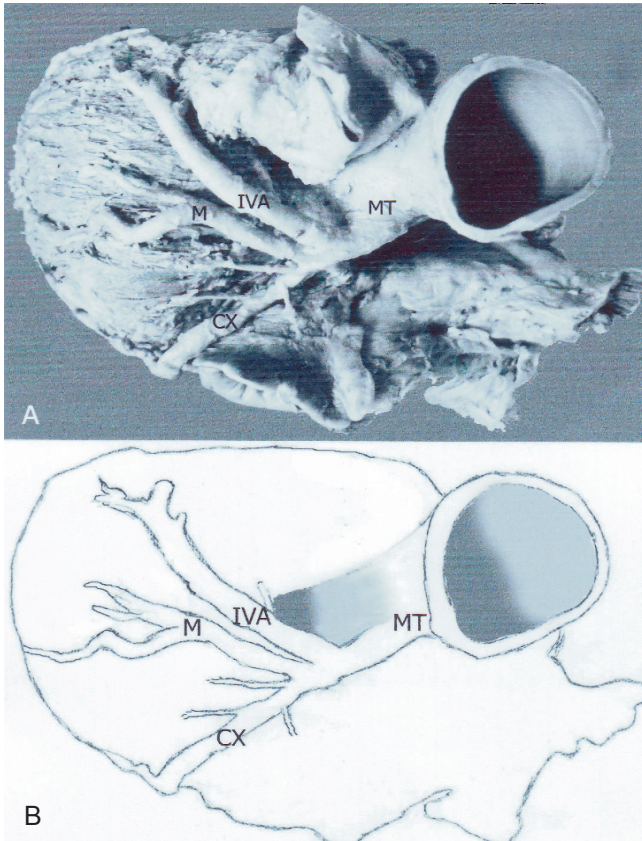
The bifurcation and trifurcation were discovered in 86% (43 cadaver hearts) and 14% (7 cadaver hearts) of the cases, respectively. The mean length of the main trunk of the left coronary artery was calculated as 1.38 mm. In the bifurcation group the mean length of the main trunk of the left coronary artery was calculated as 1.46 mm. In the trifurcation group (Figures 1A, 1B; Figures 2A, 2B) the mean length of the main trunk of the left coronary artery was calculated as 1.86 mm. In addition, the diagonal branches derived from anterior interventricular ramus were seen in 49 of the 50 hearts.



Figures 1A, 1B. The main trunk of the left coronary artery shows a division into three branches: the anterior interventricular branch, the median artery and the circumflex branch. Note that the median artery is located at the exact angle formed by the two terminal branches. CX, circumflex branch; IVA, anterior interventricular branch; M, median artery; MT, main trunk of the left coronary artery

In one of the hearts, the left coronary artery, left anterior descending artery and the circumflex artery were

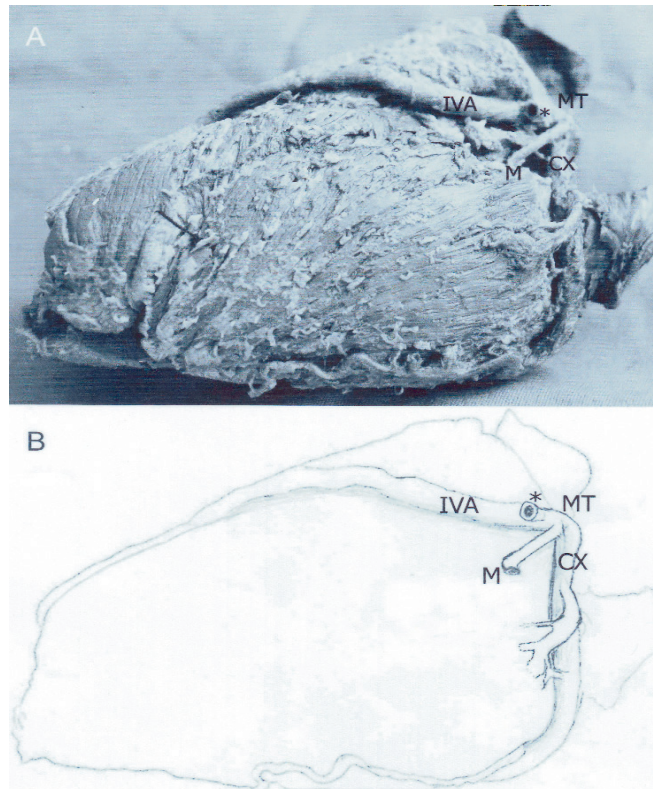
found normal. Two bridges were seen in the left anterior descending artery. Left anterior descending artery was seen before first bridge. This branch supplied the left ventricle. Continued branch anastomosed with the posterior interventricular branch of the right coronary artery on the apical cardiac notch. In addition, median artery originating from division between the circumflex artery and anterior interventricular branch of the left coronary artery was seen. The left coronary artery involved the origin of the median artery, anterior interventricular branch and the circumflex artery, producing a trifurcation lesion (Figures 1A, 1B; Figures 2A, 2B).



Figures 2A, 2B. The main trunk of the left coronary artery shows a division into three branches: the anterior interventricular branch, the median artery and the circumflex branch. CX, circumflex branch; IVA, anterior interventricular branch; M, median artery; MT, main trunk of the left coronary artery

In one of the hearts, a median artery originating from division between the circumflex artery and anterior interventricular branch of the left coronary artery was seen in the epicardial adipose tissue. In addition, a diagonal branch originating from anterior interventricular branch and two little arteries originating from the circumflex artery were found. The left coronary artery involved the origin of the median artery, anterior inter-

ventricular branch and the circumflex artery, producing a trifurcation lesion (Figures 3A, 3B).



Figures 3A, 3B. The main trunk of the left coronary artery shows a division into four branches: the anterior interventricular branch, a diagonal branch, the median artery and the circumflex branch. CX, circumflex branch; IVA, anterior interventricular branch; M, median artery; MT, main trunk of the left coronary artery, *, a diagonal branch originating from anterior interventricular branch

Discussion

Many researchers reported different results about the branching frequency of the left coronary artery, the length of the main trunk of the left coronary artery and the length of the median artery (5-8) (Table I).

We believe that third terminal branch of the main trunk of the left coronary artery should be marked as median artery. This branch, including its anastomoses, presents important pattern of the collateral blood flow, which has special meaning under conditions of coronary insufficiency (9).

The location of the left coronary artery may be defined according to its orientation on the horizontal (anterior, middle or posterior) or the frontal (upper, middle or lower) plane (7). Angioplasty of bifurcation lesions can lead to side branch occlusion secondary to plaque shifting (snow-plow effect) and retrograde propagation of dissection from side branch to parent vessel (10).

Table I. The comparison of branching frequencies of the left coronary artery, the lengths of the main trunk of the left coronary artery and the lengths of the median artery

Author	Subjects	Method	Bifurcation	Trifurcation	LMT (mm)	LMT (Bifurcation mm)	LMT (Trifurcation mm)
Kalbfleisch H and Hort W (1976)	400	Angiography	41%	53%	-	-	-
Leguerrier A, et al (1976)	80	Dissection	65-70%	20-30%	11	-	-
Reig J and Petit M (1976)	204	Dissection	-	-	11.02	-	-
Surucu HS, et al (2004)	40	Dissection	47.5%	47.5%	-	14.1	15
Present study	50	Dissection	86%	14%	7.38	7.46	6.86

LMT: Length of the main trunk of the left coronary artery

The risk of occlusion for a side branch originating at the parent vessel lesion is low if the side branch ostium has less than 50% stenosis (10,11). However, when the primary atheroma involves the side branch ostium by over 50%, the risk of side branch occlusion is quite high (14-34%), unless the side branch is protected by guide wire placement (10,11).

Angioplasty of bifurcation lesions by placing guide wires in both parent vessel and side branch is well described. Simultaneous kissing-balloon inflations then minimize the risk of side branch closure (10,12).

Khan et al. described a case of angioplasty in a coronary trifurcation lesion (10).

Anatomic variations of coronary arteries are approximately between 0.6% to 1.55% in all patients who are evaluated with coronary arteriography. Most of these variations are found by chance (13).

Finally, in our study the most frequent type of division (86%) was a bifurcation into two terminal branches: anterior interventricular and circumflex branches. In 14% of cases the division of main trunk of left coronary artery led to three branches; these complementary branches are termed as median arteries. In addition, the diagonal branches originating from anterior interventricular branch were seen in 49 hearts.

The coronary arteries and their main branches present a great quantity of variations with regard to source, trajectory and anastomoses. This knowledge is important for the interpretation of coronary angiography and surgical myocardial revascularization. In cardiology and coronary surgery, anomalies of the coronary arteries may carry a great potential risk for myocardial ischemia resulting in arrhythmia, angina pectoris, infarction and sudden death.

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