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The study of Branching pattern and variations in the left coronary artery in human heart with a unique case of crossing of coronary arteries- A cadaveric study

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Abstract

Background and Aims: Coronary artery disease is one of the major causes of death worldwide; the incidence of coronary artery disease is increasing today in developing countries, because of sedentary lifestyle, urbanization, hypertension, diabetes mellitus and increased type A personality. The increasing use of diagnostic and therapeutic interventional procedures requires a sound, basic knowledge of the coronary artery pattern. This study was undertaken to know the course, branches and variations in left coronary artery.

Materials and Method: Heart specimens were collected from cadavers during routine dissection classes conducted by the department of anatomy and preserved in 5% formalin. Hearts were dissected by underwater dissection method. Course of left coronary artery and its branches were traced carefully.

Results: In the present study bifurcation was seen in 66.67% of specimens. Trifurcation in 23.33% of specimens and quadrafurcation in 10% of specimens. Most common termination of left anterior descending artery was wrapping around the apex and terminating in the posterior interventricular sulcus and most common termination of left circumflex artery was between obtutus margin and crux.

Conclusion: Variations of coronary arteries are common. A thorough knowledge of coronary arteries will be helpful to the cardiologists and radiologists to predefine the abnormalities by invasive and non-invasive studies.

Keywords: Coronary Arteries, Trunk, Left Anterior Descending, Left Circumflex, Diagonal.

Introduction

Anatomically coronary arteries are not end arteries because they anastomose with each other by their trunks, branches and sub branches mostly at the pre capillary level. Functionally, however, they behave like end arteries, since most of the anastomoses remains impervious.(1) That is why blockage of these vessels lead to critical conditions.

Current projections suggest that India will have the largest cardiovascular disease burden in the world. One fifth of the deaths in India are from coronary heart disease. By the year 2020, it will account for one third of all deaths.(2) hence the increasing use of diagnostic and therapeutic interventional procedures require a sound, basic knowledge of the coronary artery pattern. The study of coronary arteries will be useful to the cardiologists and radiologists to predefine the abnormalities by invasive and non-invasive studies.

Most anomalies of coronary arteries have been reported as case reports. Previous studies on this research have taken their samples either from an autopsy population of congenital heart disease or from an angiographic studies done for the patients with complaints of chest pain and other symptoms of ischemic heart disease. Therefore such studies do not provide data on frequency of occurrence of variation in normal unsuspected population.

By considering the above factors, this current study is done to know the course, branching pattern and variations of left coronary artery in an unsuspected population. Anomalous coronary origin may cause potentially a dangerous symptom and even sudden death during strenuous activity. Recently coronary artery anomalies as a rare cause of coronary heart disease are going consideration in the diagnostic work up.

Materials and Methods

The present study was carried out with the permission of institutional ethical committee, in the department of anatomy. For this study 30 heart specimens were obtained from the cadavers in the department of Anatomy. All the hearts were dissected by underwater dissection method using proper scalpels. Left coronary artery and all its branches were traced carefully till they terminate.

Observation

Division of main trunk of LCA: Main trunk of left coronary artery after its origin runs for little distance and then mainly divides into left anterior descending and circumflex artery. Third branch coming from the main trunk of left coronary artery other than left anterior descending and circumflex artery is called ramus intermedius. It is seen in trifurcation of left coronary artery. In quadrafurcation total four branches arise from main trunk, they are named as ramus intermedius -1, ramus intermedius -2. These branches may act as diagonal artery and left marginal artery.

In the present study bifurcation was seen in 66.67% of specimens. Trifurcation in 23.33% of specimens and quadrafurcation in 10% of specimens.

Fig. 1: Showing bifurcation of left coronary artery

Fig. 2: Showing trifurcation of Left coronary artery

Fig. 3: Showing qudrafurcation of Left coronary artery

1. Trunk of left coronary artery
2. Left anterior descending artery
3. Ramus intermedius-1 artery
4. Ramus intermedius -2 artery
5. Left circumflex artery

The level of termination of different branches of left coronary artery

Table 1: Termination of left anterior descending artery

Termination of LAD	Number	Percentage
Before cardiac apex	01	3.33%
Reaching apex	15	50%
Wrapping around the apex & running in PIVS up to 2-5cms	14	46.67%
>5cms up in PIVS	00	00%

Table 2: Termination of left circumflex artery

Termination	Number	Percentage
Before obtutus border	02	6.66%
Between obtutus margin &crux	18	60%
At the crux	08	26.67%
Between crux& acutus border	02	6.66%

Table 3: Level of termination of left diagonal artery

Termination	Number	Percentage
Before apex	23	76.67%
At apex	07	23.33%
Beyond apex	00	00

Left diagonal artery was terminated at apex in 23.33% of specimens and terminated before reaching apex in 76.67 % of specimens.

In specimen no. 7 left diagonal artery showed aberrant course. It took origin from left circumflex artery and then it travelled downwards and medially, crossed over the middle of anterior descending artery from lateral to medial reaching upto inferior border.

Fig. 4: Showing crossing of diagonal artery over left anterior descending artery

Discussion

Comparison of termination of left circumflex artery: The division of main trunk of coronary artery is variable. Most common division is bifurcation, it divides into left anterior descending and left circumflex artery. Second most common is trifurcation giving diagonal branch as the third branch. Sometimes division is quadrafurcation and pentafurcation giving diagonal branches. In the

present study bifurcation was seen in 66.67%, trifurcation in 23.33% and quadrafurcation in 10% of cases.

Table 4: Comparison of division of main trunk of LCA

Division	One branch	Bi-furcation	Tri-furcation	Quadra-furcation	Penta-furcaion
Kalpana R[3] (2003)	1%	47%	40%	11%	1%
Ballesteros LE et al.[4] (2008)	---	52%	42.2%	5.8%	---
Fazilio gullari et al.[5] (2011)	---	46%	44%	10%	---
Bhimalli S et al.[6] (2011)	---	56.6%	33.3%	8.33%	1%
Present study	---	66.67%	23.33%	10%	---

Comparison of termination of left anterior descending artery: In the present study left anterior descending artery was terminated at apex in 50% of specimens, in 46.6% of specimens it was wrapping around the apex supplying the inferoapical segment, terminating at the lower third of posterior interventricular sulcus. In 3.33% specimens it was terminated before reaching the cardiac apex. It correlates with the study done by Ballesteros et al.[4] in 2008 in which it was terminated before apex in 1.3% of cases, at apex in 42% of cases and at lower 1/3rd of posterior interventricular sulcus in 63.6% at median third of PIVS in 4% cases, between inferior border and median third of interventricular sulcus in3.3% of cases. Another study done by Kalpana R,[3] in 2003 left anterior descending branch was terminated at the anterior apex in 8%, at the posterior apex in 12%, 2-5 cm up in the PIVS in 80% of cases.

In specimen no.7 crossing of coronary arteries was found. Left diagonal artery showed aberrant course. It took origin from left circumflex artery and then it travelled downwards and medially, crossed over the middle of anterior descending artery from lateral to medial reaching just before the inferior border. Such variation is very rare in literature and is also reported by few of the others. In 2005 Czekajska - Chehab E. et al. reported an unusual crossed course of separately originating left circumflex and left anterior descending arteries in multislice computed tomography.[7]

Zegers, M.W.A. et al. in 2007 reported one more case of crossing of coronary arteries in a 73year old patient of aortic stenosis. Coronary angiography revealed significant lesions in the left anterior descending coronary artery and circumflex artery, the obtuse marginal artery was dividing into two branches which were crossing each other and there was no angiographic evidence of bridging.[8]

Conclusion

Better anatomical knowledge about the branches of coronary artery and its variation is essential for interventional cardiologists and radiologists for better interpretation of coronary angiograms. The present study also showed crossing of coronary arteries, which plays important role in coronary artery bypass graft.

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