A study of coronary ostia in north Karnataka region

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Abstract

Introduction: The knowledge of origin of coronary arteries from respective sinuses and their variations are of supreme importance for interventional cardiologists. Previously there have been reports of variations in coronary ostia in number, origin and position of sinuses, hence this study was undertaken to get more insight on the same in North Karnataka region.

Materials and Methods: 100 adult heart specimens were collected from routine under graduate and post graduate dissection at Belgaum Institute of Medical Sciences, Belagavi. The position and location of coronary ostia in relation to Sino tubular junction were noted. Photographs of variations were taken wherever necessary and results were compared with previous studies.

Results: Out of 100 specimens studied in all the 100 (100 %) specimens the coronary ostia were two in number, one for right coronary artery arising from right anterior aortic sinus and another for left coronary artery arising from left posterior aortic sinus. The coronary ostia were present either below or at the Sino tubular junction in 96 (96 %) specimens and in 4 specimens (4 %) it was present above the Sino tubular junction. The importance of these findings is discussed in detail.

Conclusion: The knowledge of normal anatomy and variations of coronary ostia will help interventional cardiologist, cardio-thoracic surgeons and radiologist of North Karnataka region in proper management of patients with variations during procedures where artificial myocardial perfusion is necessary.

Keywords: Coronary Ostia, Sino tubular junction, Coronary angiography, CABG.

Introduction

The main source of oxygen and nutrients for the human body is blood. To circulate blood throughout the body special circulatory organs are required and they are the heart and the blood vessels. The heart is a muscular pump with four chambers, which receives oxygenated blood from the lungs and pumps it to each and every cell in the body and receives deoxygenated blood from them and pumps it to lungs for oxygenation. The heart, which is all the time filled with blood in the chambers, does not get nutrition from them. The heart is supplied by special sets of vessels and which are called as the coronary arteries. Coronary arteries branch in such a manner that they occupy the atrioventricular and interventricular sulci in the shape of an inverted crown. The word coronary is derived from the Latin word co-ro-ne, Greek- ko ro ne, means anything hooked or curved. "Corona" meaning "Crown".[(1)]

Two coronary arteries supply the heart, namely right coronary artery and left coronary artery. The right and left coronary arteries arise from the ascending aorta in its anterior and left posterior aortic sinuses respectively.[(2)] The levels of the coronary ostia are variable.

First human coronary angiograph was invented in year 1928, when Werner Forssmann inserted a urethral catheter into his left antecubital vein and advanced it to the heart. Today coronary angiographies and elective coronary angiographies are being done quite frequently. Presence of supernumerary ostia can make it difficult to correctly interpret angiographic films. Also during elective angiography such ostia are difficult to cannulate. The knowledge of the position of coronary ostia in aortic sinuses and possible variations in their locations will aid to carry out these procedures as well as in interpreting them.[(3)]

This study will help anatomists, interventional cardiologist, cardio-thoracic surgeons and radiologist of North Karnataka region in better understanding of the normal anatomy of coronary ostia and also to identify and properly manage any variations seen in the same during coronary angiographies, CABG operations and other heart related surgeries where artificial myocardial perfusion is necessary.

Materials and Methods

100 adult heart specimens were collected from routine under graduate and post graduate dissection at Belgaum Institute of Medical Sciences, Belagavi. Hearts with any congenital anamolies, damage due to trauma or external deformities were excluded. These specimens were fixed in 10% formalin. The ascending aorta was dissected and the origin of the coronary arteries was observed minutely. The ascending aorta was transversally sectioned approximately 1 cm above the commissures of the aortic leaflets. Then, the aorta was longitudinally slit at the level of the right posterior aortic sinus (non-coronary sinus) to visualize the right anterior and left posterior aortic leaflets and their respective coronary ostia. Photographs were taken wherever necessary. The data was collected, analyzed and compared with available data.

Results

In all the 100 adult heart specimens studied the numbers of coronary Ostia were two, one each for right coronary artery and left coronary artery. The origin of these two ostia for right coronary artery and left coronary artery were from right anterior aortic sinus and left posterior aortic sinus respectively in all the cases (Table 1). The LAD, LCx artery or any diagonal arteries did not origin directly from any of the sinuses and hence only two coronary ostia were seen in all the specimens, and neither of the ostia were seen arising from non-coronary sinus.

Table no 2 shows the distribution of relation of the ostium of RCA and LCA with the Sino tubular junction of the aortic sinuses in the ascending aorta. Out of 100 specimens studied both coronary sinuses were below the Sino tubular junction in 85 (85 %) specimens (Fig. 1). In 11 (11 %) specimens both ostia was present at the level of the Sino tubular junction (Fig. 2) while in 4 (4 %) specimen they were seen above the level of the Sino tubular junction (Fig. 3).

Fig. 1: Showing the ostium of LCA below the supravalvular ridge

Fig. 2: Showing the ostium of LCA at the level of supravalvular ridge

Fig. 3: Showing the ostium of LCA above the supravalvular ridge

Discussion

Table no 3 shows the comparison of the distribution of No. of ostia of LMCA with previous workers. The LCx originating from LPAS along with LCA was found in study done by Reig J and Petit M[4] in 4 specimens. But in the present study we did not find any such variations and there was only one ostium for LMCA in each specimen studied, which was similar to the studies done by Vaishaly K B,[5] Kalpana[6] and Shilpa B et al.[7] P R Roy studied 200 cases of coronary angiogram in which he found 5 cases of anomalous origin of LCx where he found total absence of LCA in one case and the blood supply to left heart was from 3 anomalous vessels arising from proximal RCA, so there was no ostium for LMCA.[8] No such findings were seen in the present study.

Table no 4 shows the comparison of the distribution of origin of LMCA from the aortic sinuses. All the previous workers like Kalpana,[6] Shilpa B et al.,[7] Vaishaly K B[5] found the RCA and LMCA originating from the RAAS and LPAS respectively in all the specimens studied. This result was similar in the present study where in all 100 specimens the RCA and LMCA were originating from RAAS and LPAS respectively. P. Dharmendra et al.[9] found in one of the specimen that the LMCA originated from the RAAS but no such variation was found in the present study. No author found LMCA originating from non-coronary sinus.

During open heart surgeries, it is very difficult to cannulate the vessels which arise from the anomalous ostia. Before performing coronary angiography and arteriography, a preliminary aortic root injection of the dye should be given to locate the exact no. of ostia and coronary arteries so that fatal outcomes can be prevented. The multiple coronary ostia may be associated with cardiac diseases like hypertrophic cardiomyopathy and are rarely associated with congenital coronary anomalies. The knowledge of the existence of such multiple ostia is important to correctly interpret the angiographic findings.[10]

The presence of supernumery ostia has not been associated with clinical symptoms as reported in literature. To confirm the clinical association between anomalous ostia and pathophysiological conditions, the correlation needs to be studied in living subjects who are investigated for multiple ostia by non-invasive techniques like computed tomography. Individuals with multiple ostia should be followed up regularly to watch out for any related symptoms of angina, myocardial infarction, left ventricular dysfunction, etc. Although this process would be very impracticable, expensive and time consuming, it will eliminate any selection bias associated with cardiac patients and help to confirm any association between the presence of multiple ostia and clinical symptoms.[11]

Table no 5 shows the comparison of the studies of previous workers on distribution of the level of ostium of LMCA in relation to the sinotubular junction. The ostium of LMCA was found in LPAS below the sinotubular junction in 80 % of specimens studied by Kalpana[6] and in 93 % of specimens studied by Shilpa

B et al.[7] Similarly, in 85 % specimens of the present study showed the ostia below the sinotubular junction.

In 66 % of the specimens studied by Vaishaly K B and Vasanti A[3] the ostium of LMCA was present at the level of the sinotubular junction, but it was seen at the same level in 20 % of specimens in the study by Kalpana[6] and in 6.6 % specimens in study by Shilpa B et al.[7] In the present study it was seen at the level of sinotubular junction in 11 % of specimens.

The ostium was present above the ridge in 3.3 % specimens in study by Shilpa B et al.[7] and in 24 % of cases in the study by Vaishaly K B and Vasanti A.[3] In the present study it was seen above the ridge in 4 % of specimens. The present study results matched more with the results of Shilpa B et al.,[7] less with Kalpana[6] and least with Vaishaly K B and Vasanti A.[3] This variation may be due to the different regions of study. As study by Shilpa B et al.[7] and present study are from same region, the results correlate with each other.

The coronary arteries arising within the aortic sinuses or at the sinotubular junction allow maximum coronary filling during ventricular diastole.[12] In the present study 96 % of individuals show chances of maximum diastolic filling of LCA as 85 % of specimens had ostia below the level of supravalvular ridge and 11 % of individual had the same at the level of ridge.

Alexander[12] and Vlodaver[13] described "High take off coronary artery" as an artery whose orifice is situated 10 mm or more above the line of the sinotubular junction. The diagonsis of such high originating coronary arteries is clinically significant because high origin of coronary artery can decrease the diastolic coronary arterial filling. Such arteries are at a risk in case of low level clamping of aorta during surgeries like valve replacement.[13] They can also be missed during procedures like coronary angiography. No such high take off coronary artery was seen in the present study.

Table 1: Showing the distribution of number of ostia in present study

No of Ostia in each sinus	Right Anterior Aortic Sinus (n = 100)	Left Posterior Aortic Sinus (n = 100)	Non Coronary Sinus (n = 100)
0	0	0	0
1	100	100	0
2	0	0	0

Table 2: Showing the distribution of relation of the coronary ostia with the sinotubular junction in present study

Relation of the ostia to the Sinotubular junction	No. of specimens	Percentage
Above the junction	4	4 %
Below the junction	85	85 %
At the level of the junction	11	11 %

Table 3: Showing the comparison of the distribution of No. of ostia of LMCA with previous workers

No. of ostia of LMCA	Reig J and Petit M (n = 100)	Vaishaly K B & Vasanti A (n = 50)	Shilpa Bhimalli et al. (n = 60)	Kalpana (n = 100)	Present study (n = 100)
0	0	0	0	0	**0**
1	96 %	100 %	100 %	100 %	**100%**
2	4 %	0	0	0	**0**

Table 4: Showing the comparison of the distribution of origin of LMCA with previous workers

Origin of LMCA	P Dharmendra et al. (n = 93)	Kalpana R (n = 100)	Shilpa Bhimalli et al. (n = 60)	Vaishaly K B & Vasanti A (n = 50)	Present study (n = 100)
LPAS	98.93 %	100 %	100 %	100 %	**100%**
RAAS	1.07 %	0	0	0	**0**
Non Coronary Sinus	0	0	0	0	**0**

Table 5: Showing the comparison of distribution of the level of ostium of LMCA in relation to the supravalvular ridge with previous workers

Relation of the ostia to the Sinotubular junction	Vaishaly K B & Vasanti A (n = 50)	Kalpana R (n = 100)	Shilpa Bhimalli et al. (n = 60)	Present study (n = 100)
Above the junction	24 %	0	3.3 %	**4 %**
Below the junction	10 %	80 %	93 %	**85 %**
At the level of the junction	66 %	20 %	6.6 %	**11 %**

Conclusion

The anomalous origin of arteries is important because, to prevent fatal outcomes while performing coronary angiography. It becomes very difficult to cannulate these vessels which arise from the anomalous ostia during open heart surgeries. The multiple coronary ostia may be associated with cardiac abnormalities like hypertrophic cardiomyopathy and are rarely associated with congenital coronary anomalies. The knowledge of normal anatomy and the existence of such multiple

ostia is important for interventional cardiologist, cardio-thoracic surgeons and radiologist of North Karnataka region to correctly interprete the angiographic findings. Individuals with multiple ostia should have regular follow up to watch out for any coronary artery disease related symptoms though correlation of multiple ostia and clinical symptoms is not much studied.

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