

**MYOCARDIAL BRIDGES AND CORONARY DOMINANCE**Vijayamma Kunnath Narayanan<sup>1</sup>, Ushavathy Padmanabhan<sup>2</sup><sup>1</sup>Professor and HOD, Department of Anatomy, Government Medical College, Kottayam, Kerala, India.<sup>2</sup>Associate Professor, Department of Anatomy, Government Medical College, Kottayam, Kerala, India.**ABSTRACT****BACKGROUND**

Myocardial bridges are bands of cardiac muscle fibers, which bridges across the coronary arteries and its main branches. It is considered as a congenital anatomical variant mainly seen across the left anterior descending artery. Myocardial bridges may cause coronary heart disease either by compressing the underlying artery during cardiac systole or inducing atherosclerotic changes in the artery proximal to the myocardial bridge. The degree of coronary obstruction depends on the position, length, breadth and thickness of the muscle bridges. In this study, the myocardial bridges over the two coronary arteries and its main branches, gross anatomical changes of the tunnelled arteries and coronary dominance were observed.

**MATERIALS AND METHODS**

Ninety human heart specimens including five foetal were collected and fixed in 10% formalin. Coronary arteries were traced and myocardial bridges were looked for along the course of the artery and its position, type, measurements and dominance were tabulated. The gross features of the tunnelled arteries were also observed.

**RESULTS**

The incidence of myocardial bridges in 90 heart specimens was 63.3%. It is most prevalent in the middle third of the Left Anterior Descending (LAD) artery 61.4%. The percentage bridges over Posterior Descending Artery (PDA) 15.79, right coronary artery 7, left circumflex 8.77 and diagonal 7 were tabulated. The average length, breadth and thickness of MB in LAD was 38 mm x 10 mm x 2 mm. The largest and deep bridges were noticed over the diagonal artery with an average measurement of 45 mm x 25 mm x 20 mm. Right coronary dominance was observed in 77.12% hearts having MB.

**CONCLUSION**

Myocardial bridges are congenital anatomical variants and asymptomatic when it is thin and superficial. But, it produces coronary arterial compression and haemodynamic changes when it appears thick and deep. Myocardial bridges are more common in middle third of the LAD and also found in multiple sites in the same LAD and other branches. The association of right dominance with myocardial bridges in LAD may protect the myocardium from ischaemic changes.

**KEYWORDS**

Heart, Myocardial Bridges, Coronary Artery, Coronary Dominance.

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**BACKGROUND**

Myocardial bridges are groups of cardiac muscle tissue, which bridges across the coronary arteries and its main branches. Normally, coronary arteries and their branches were subepicardial and have a winding course around the heart even at birth. The ventricular branches pass almost obliquely from the parent trunk. Myocardial bridges or atrioventricular loops run over these vessels while it courses along the atrioventricular and interventricular groove. The term myocardial bridge was first described by Rayman (1737)<sup>1</sup> in the left coronary artery. Geringer (1951)<sup>2</sup> and

Polacek (1961)<sup>3</sup> reported the presence of myocardial bridge in left anterior descending branch of left coronary artery. Stefan et al in 2002<sup>4</sup> observed the myocardial bridges in one third of adult population of which 40% cases were in the middle segment of left anterior descending artery. Recently, multidetector CT were available to visualise the course and distribution of the artery and presence of myocardial bridges, which are more reliable and sensitive. The present study is aimed at observing the position, type (superficial or deep), average length, breadth, thickness of bridge and coronary dominance. The characteristic gross changes of the tunnelled arteries were also observed. The main branches of the coronary arteries are distributing vessels and they carry blood to the borders of the myocardial zone, while diagonal, right and left ventricular and septal branches are delivering vessels (Farrer-Brown, 1968).<sup>5</sup> So, the myocardial ischaemic changes are less when the distributing vessels are involved than the delivering vessels.

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**AIM AND OBJECTIVES**

Myocardial bridges were regarded as anatomical variants rather than a congenital anomaly (Konen E et al 2008). 6 out of 5 foetal hearts, MB was present in 3 cases (60%) and 63.3% in 90 hearts. The present study showed that 61.4% affect the middle segment of Left Anterior Descending (LAD) artery having varying degrees of length and thickness. Thin myocardial bridges may not have much clinical significance, but myocardial ischaemia may occur when it is thick and compress the artery during cardiac systole.

**MATERIALS AND METHODS**

Total of 90 hearts were made use for the study after obtaining permission from ethical committee. The specimens including foetal hearts were collected from Department of Forensic Medicine and Department of Gynaecology and from cadavers of dissection hall, Government Medical College, Kottayam, Kerala. The hearts were fixed in 10% formalin and subjected to dissection studies. The right and left coronary arteries were traced along its course after removing the subepicardial pad of fat. First, the right coronary artery was traced from anterior aortic sinus along the coronary sulcus till its termination and observed myocardial bridges along its course. Then, the left coronary was also traced from posterior left aortic sinus and its branches are noticed along its course. The position, type, length and thickness of myocardial bridges were observed, tabulated and subjected to statistical analysis. Gross anatomical changes of the tunnelled arteries were also observed.

**RESULTS AND OBSERVATION**

Observations were made on the basis of gross anatomical study by dissection. Myocardial bridges were looked for along both coronary arteries and their main branches. The position, length, breadth and thickness of myocardial bridges were observed and tabulated. The gross features of the tunnelled arteries were also observed. Out of the 90 hearts dissected, myocardial bridges were observed in 57 specimens (63.3%) (Table I and Chart I) of which 35 cases (61.4%) were in the anterior descending branch of the left coronary artery. Myocardial bridges were seen in posterior descending artery in 9 specimens (15.8%) over the right coronary in 4 specimens (7%), left circumflex artery in 5 specimens (8.8%) and diagonal branch in 4 specimens of hearts (7%) (Table II and Chart II). Myocardial bridges were seen in the middle third of the Left Anterior Descending (LAD) artery in 27 hearts including 3 foetal hearts out of 35 cases (77.1%) and in 5 cases (14.3%) in the proximal one third and 3 cases (8.5%) distal one third (Figure 1, Figure 2 and Table III). In one specimen, the MB was seen in both proximal third and distal third (Figure 3). Myocardial bridges were seen as very thin loops along the length of the middle segment of LAD in another heart (Figure 4). Since the bridges were superficial, there was no narrowing of the tunnelled arteries were observed. The average length, breadth and thickness measured was 38 mm, 10 mm and 2 mm, respectively (Table IV). It was also observed that out

of 57 specimens of MB 77. 12% were right dominant and 22.88% were left dominant (Table V).

**Inclusion and Exclusion Criteria**

Myocardial bridges were seen over Posterior Descending Arteries (PDA) in 9 specimens (15.78%) out of 57 cases. Middle one third was involved in 6 specimens (66.7%), proximal one third in 1 heart (11.1%) and distal one third in 2 hearts (22.2%) out of 9 cases of myocardial bridges. Bridges are thin, superficial and transverse. Average measurements were 25 mm length, 5 mm breadth and 2 mm thickness (Table IV). There was slight narrowing of the underlying vessels noticed in 2 cases with tortuosity in the post MB segment (Figure 5 and Figure 6).

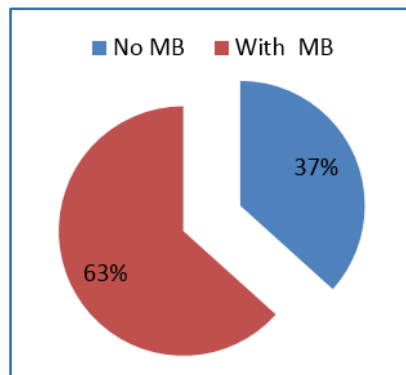
The myocardial bridges of right coronaries were seen as very thin loops, which consists of fine muscle fibers, connective tissue and fat. Out of the 4 specimens (7.01%), 3 cases were present in the anterior part of the coronary sulcus and 1 case was present in the posterior part of the coronary sulcus (Figure 7). There was no narrowing or tortuosity of the vessel noticed. The average measurement was 20 mm x 10 mm x 0.5 mm. The coronary dominance was 50% each.

Myocardial bridges of Left Coronary Arteries (LCA) were seen as thin atrioventricular loops in 5 cases (8.8%), along its course in the anterior and posterior part of the coronary sulcus (Figure 8). In 1 case, there were two bridges one on the circumflex and other on the PDA (Figure 9). Average measurements of the myocardial bridges in the circumflex artery were 20 mm x 10 mm x 0.5 mm. Three of them were seen left dominant hearts and two were in the right dominant. No narrowing of vessels was noticed.

Diagonal arteries having myocardial bridges account for 4 cases (7.01%). The bridges were longitudinally placed arising from the apex of the left ventricle and directed upwards. The average measurements were 45 mm x 25 mm x 20 mm. The arteries were deeply placed and exhibit narrowing. The post myocardial bridge segment of the artery was tortuous and dilated (Figure 10). All the 4 heart specimens were right dominant.

Total Number Specimens	Total Number of MB	Percentage
90	57	63.3

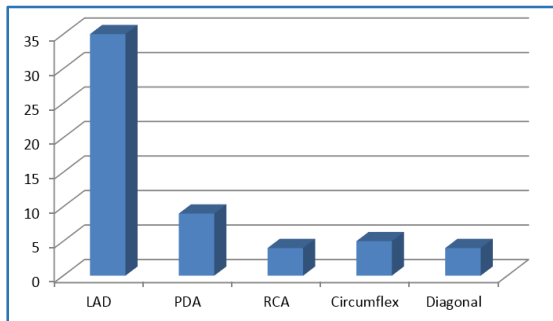
**Table I. Showing Total Number Specimens, Total Number of MB and Its Percentage**



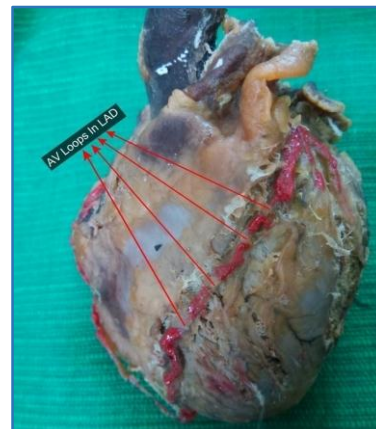
**Chart I. Showing Percentage of MB Seen (63%) and Hearts without MB (37%)**

	MB Seen					Total
	LAD	PDA	RCA	Circumflex	Diagonal	
Number of hearts	35	9	4	5	4	57
Percentage of incidence	61.4	15.79	7.01	8.77	7.01	100

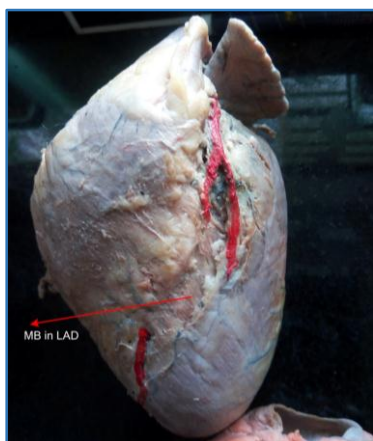
**Table II. Showing Percentage of Incidence of MB in Different Branches of Coronary Arteries**



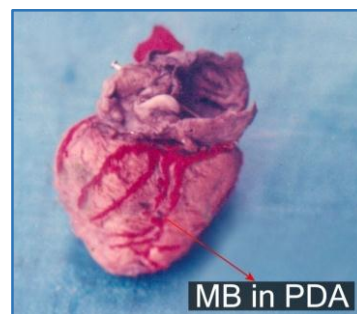
**Chart II. Showing Number of MB in Different Branches of Coronary Arteries**



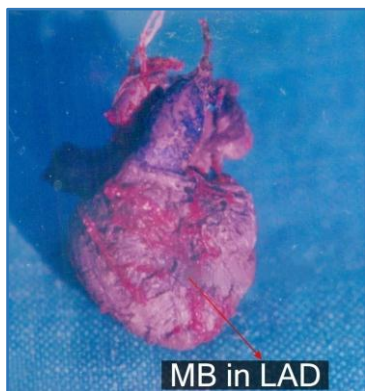
**Figure 4. Anterior Ventricular Loops over LAD Artery**



**Figure 1. MB in LAD Artery**



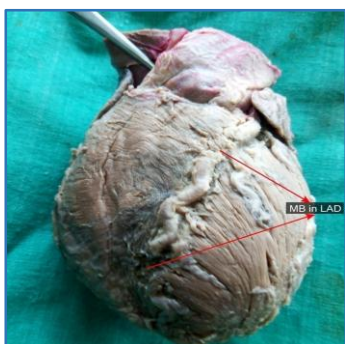
**Figure 5. MB in PDA of 36 Weeks Old Foetus**



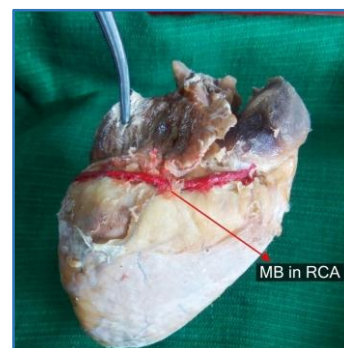
**Figure 2. MB in LAD of a Full-Term Foetus**



**Figure 6. MB in Middle Third of PDA**



**Figure 3. MB Over LAD Seen in Proximal Third and Distal Third**



**Figure 7. MB in RCA in the Anterior Part of Coronary Sulcus**



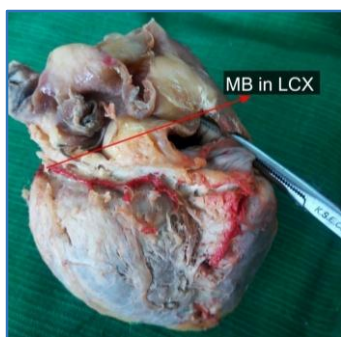


Figure 8. MB in LCA Artery

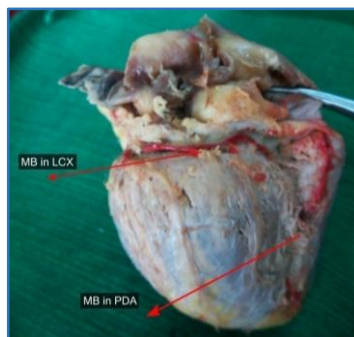


Figure 9. MB in LCA and PDA

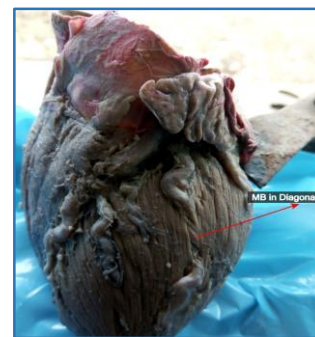


Figure 10. MB in Diagonal Artery

Parameters	LAD	PDA	RCA	LCA	Diagonal
Length (mm)	38	25	20	20	45
Breadth (mm)	10	5	10	10	25
Thickness (mm)	2	2	0.5	0.5	20

Table III. Showing Positions of MB in Different Branches of Coronary Arteries and its Percentage

**DISCUSSION**

Myocardial bridges were studied by many researchers as early as 12<sup>th</sup> century and is continuing. There were variations seen in the statistical data probably due to the methodology adopted for the studies. Higher percentage was observed in dissection method, whereas angiographic study shows lesser incidence. In the present study, MB were seen in 57 specimens (63.3%) out of 90 hearts dissected and of which 93% cases were superficial bridges. The tunnelled arteries along with accompanying veins did not show much narrowing. Hence, it is not affected by the haemodynamic changes during cardiac systole. MB compression producing more than 75% narrowing of the artery during cardiac systole could produce severe myocardial ischaemia, which is revealed by angiography (Noble J et al 1976).<sup>7</sup> It was also found that longer and thicker myocardial bridges in LAD has a significant association with more severe systolic compression (Tsujita K Maehara et al 2008).<sup>8</sup> In the present study, the incidence of MB in LAD was 61.4%, whereas Geiringer, Polacek and Loukas M (2006).<sup>9</sup> It was 23%, 25% and 17.5%, respectively. High incidence of bridges (77.1%) were observed in the middle one third of LAD reported in the present study almost correlate with the study of Vanlido (2002)<sup>10</sup> whose observation showed a high incidence (88.6%). Myocardial bridges over PDA observed in the present study was 15.79% with a relatively higher incidence in the middle third compared to the study of Loukas (4%). The incidence of MB seen over the right coronary artery (7%), circumflex artery (8.85%) and diagonal artery (7%) were also higher when compared with the previous studies. In the present study, it was observed that MB were seen in the proximal and distal segment of the same LAD with dilatation and tortuosity of the middle segment (Figure 3). The multiple loops of MB throughout the middle segment of LAD was seen in one specimen was not reported before (Figure 4). MB over PDA and circumflex artery was also observed together in one heart was also not reported earlier (Figure 9). The average length of MB observed was 38 mm, 25 mm, 20 mm, 20 mm, 45 mm over LAD, PDA, RCA, LCA and diagonal, respectively. The length of the MB is usually

within 10 to 30 mm range and rarely exceed 40 mm (Dan Dermengiu et al 2010).<sup>11</sup> But, the present study, the range of length exceeds the above findings. A longer MB was associated with more significant haemodynamic effect and clinical symptoms.

According to the study of Loukas, myocardial bridges were related to coronary dominance.

Coronary dominance maybe classified into right, left and balanced type according to the origin of posterior interventricular artery. In the present study, it was observed that 52.6% of MB over LAD were present in right dominant heart and only 8.8% of MB over LAD were left dominant heart. It was also observed that 10.5% of MB over PDA, 3.5% over RCA, 5.3% over LCA and 5.3% over diagonal are found to be present in the right dominant heart. The present study revealed that 77.12% of hearts are right dominant and 22.88% are left coronary dominant having myocardial bridges. Loukas reported that 21% of myocardial bridges were seen in left coronary dominant heart, which correlate with the present study.

**CONCLUSION**

The study of myocardial bridges by many authors agreed that their existence definitely modulate the coronary haemodynamics even though its frequency, location and morphology showed wide range of variations. The existence of myocardial bridges in foetal life throws light upon its source of development from the mesenchyme surrounding the endothelial heart tube. The mesothelial cells originating in the outflow tract region of the heart tube forms the source of development of part of the epicardium and coronary arteries, hence the possibility of arteries being covered by myocardial tissue. In the present study of 90 hearts, myocardial bridges were seen in 57 cases (63.3%) and more seen over the LAD in 35 cases (61.4%) and out of which 77% were found in the middle third of LAD. The myocardial bridges were observed in 9 cases (15.78%) over PDA and 7% in RCA, 8.8% in circumflex and 7% over diagonal artery. In the present study of myocardial bridges, 77.12% of hearts were right dominant. The association of right dominance

with myocardial bridges on LAD may protect the ventricular myocardium and septum from ischaemic changes by providing alternate blood supply through posterior descending artery.

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